UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

September 20, 2004

Mr. David E. Strainge
AFBCA/DA Loring, Pease, & O'Hare
154 Development Drive, Suite G
Limestone, ME 04750-9743

Re: Five-Year Review Report (1999 to 2004), Pease Air Force Base NPL Site

Dear Mr. Strainge:

This office is in receipt of the Air Force's *Five-Year Review Report (1999-2004), Pease Air Force Base* dated September 15, 2004. Upon review of this report, EPA concurs with the findings that all remedies which have been implemented are currently protective of human health and the environment.

This second five-year review was triggered by the first remedial action which was documented by EPA to be September 30, 1994. Consistent with Section 121(c) of CERCLA and EPA's *Comprehensive Five-Year Review Guidance* (OSWER *Directive 9355.7-03B-P)*, the next statutorily required five-year review must be finalized by September 30, 2009.

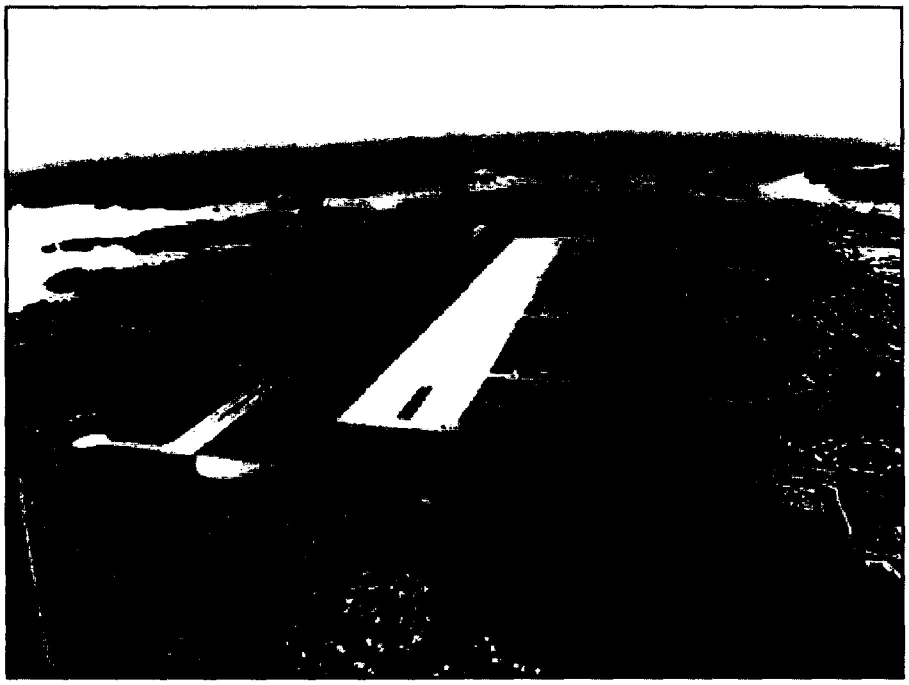
Sincerely,

for Susan Studlien, Director
Office of Site Remediation and Restoration

cc: Bryan Olson, EPA-New England
Mary Sanderson, EPA-New England
Mike Daly, EPA-New England
Jim Konz, EPA HQ
Scott Hilton, NHDES

SDMS DocID 000204871

U.S. AIR FORCE



Former Pease Air Force Base
Portsmouth, New Hampshire

5 Year Review Report (1999 to 2004)

September 2004
Contract No. F41624-03-D-8608
Task Order No. 058

FORMER PEASE AIR FORCE BASE
FIVE-YEAR REVIEW REPORT (1999-2004)

Prepared for:

Air Force Real Property Agency (AFRPA)
154 Development Drive, Suite G
Limestone, Maine 04750

Air Force Center for Environmental Excellence (AFCEE)
Base Closure Division (AFCEE/ERB)
Brooks City-Base, TX 78235-5328

Prepared by:

MWH Americas, Inc.
335 Phoenixville Pike
Malvern, PA 19355

September 2004

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ACRONYMS AND ABBRIVIATIONS

µg/L	Micrograms per liter
1,2,4-TMB	1,2,4-trimethylbenzene
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AFRPA	Air Force Real Property Agency
AGQS	Ambient Groundwater Quality Standards
ARAR	Applicable or Relevant and Appropriate Requirements
AS	Air Sparging
ASV	Air Supply Vents
AVGAS	Aviation Gasoline
BA-1	Burn Area 1
BA-2	Burn Area 2
BCT	BRAC Cleanup Team
BFSA	Bulk Fuels Storage Area
bgs	feet below ground surface
BRAC	Base Realignment and Closure
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	Cleanup Goals
cis-1,2-DCE	cis-1,2-dichloroethene
COC	Contaminants of Concern
CRD	Construction Rubble Dump
CREW	Concrete Recovery Extraction Well
CVOC	Chlorinated Volatile Organic Compound
DCA	identified 1,1-dichloroethane
DCE	1,1-dichloroethene
DNAPL	Dense Non-Aqueous Phase Liquid
DOD	Department of Defense
DOI	Department of Interior
DPE	Dual Phase Extraction
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ERL	Effects Range-Low
ESD	Explanation of Significant Differences
ETI	Environmental Technologies, Inc.
FDTA-1	Fire Department Training Area 1
FDTA-1	Fire Department Training Area 1
Fe^0	zero-valent iron
FFA	Federal Facilities Agreement
FMS	Field Maintenance Squadron
FS	Feasibility Study
ft	Feet
ft./sec.	feet per second
ft/day	feet per day

ACRONYMS AND ABBRIVIATIONS

GAC	Granular Activated Carbon
gal	Gallon
GMZ	Groundwater Monitoring Zone
gpm	Gallons per minute
GT	Glacial Till
GWTP	Groundwater Treatment Plant
HHCs	Halogenated Hydrocarbons
HMSA	hazardous materials storage area
IC	Institutional Controls
IR	Intrinsic Remediation
IRIS	Integrated Risk Information System
IRM	Interim Remedial Measure
IRP	Installation Restoration Program
JETC	Jet Engine Test Cell
JP-4	jet fuel
LF1	Landfill 1
LF5	Landfill 5
LFTS	Leaded Fuel Tank Sludge Area
LNAPL	Light Non-Aqueous Phase Liquid
LS	Lower Sand
LTM	Long-Term Monitoring
LTMP	Long Term Monitoring Plan
LUC	Land Use Control
MCL	maximum contaminant level
MCS	Marine Clay and Silt
MRDDA	McIntyre Road Drum Disposal Area
MSL	mean sea level
MWH	MWH Americas, Inc.
NCP	National Contingency Plan
NFA	No Further Action
NHAGQS	New Hampshire Ambient Groundwater Quality Standards
NHANG	New Hampshire Air National Guard
NHDES	New Hampshire Department of Environmental Services
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
O&M	onsite Operations and Maintenance
OJETS	Old Jet Engine Test Stand
OPS	Operating Properly and Successfully
PAH	Polynuclear Aromatic Hydrocarbons
PCB	410/polychlorinated biphenyls
PCDA	Paint Can Disposal Area
PCE	tetrachloroethene
PCMMP	Post Closure Maintenance and Monitoring Plan
PDA	Pease Development Authority
Pease AFB	Pease Air Force Base

ACRONYMS AND ABBRIVIATIONS

PRB	permeable reactive barrier
PVC	Poly-Vinyl Chloride
RAB	Restoration Advisory Board
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RG	Restoration Goals
RI	Remedial Investigation
RI/FS	remedial investigation and feasibility study
RO	remedial objectives
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SBR	shallow bedrock
SI	site inspection
SQuiRTs	Screening Quick Reference Tables
SSLTMP	System Startup and System Long Term Monitoring Plan
SVE	soil vapor extraction
TBC	to be considered
TCE	Trichloroethylene
TEL	Threshold Effects Level
TI	Technical Impracticability
TPHs	total petroleum hydrocarbons
TSL	Temporary Sample Location
US	Upper Sand
USAF	U. S. Air Force
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WQC	New Hampshire Water Quality Criteria for Toxic Substances
yd^3	Cubic yard

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name (from WasteLAN): Pease Air Force Base

EPA ID (from WasteLAN) : NH7570024847

Region: 1	**State:** NH	**City/County:** Portsmouth, Newington, Greenland/Rockingham

SITE STATUS

NPL Status: X Final Deleted Other (specify)

Remediation Status (choose all that apply): Under Construction **X** Operating **X** Complete

Multiple OUs? **X** Yes No	**Construction completion date:** 09/26/2000

Has Site been put into reuse? **X** Yes No

REVIEW STATUS

Lead Agency: EPA State Tribe **X** Other Federal Agency United States Air Force

Author name: Julie A Widman

Author title: Principle Hydrogeologist	**Author affiliation:** Montgomery Watson Harza

Review Period: 9 / 30 / 1999 to 9 / 20 / 2004

Date(s) of inspection: N/A (see report)

Type of Review: **X** Post-SARA Pre-SARA NPL-Removal Only
Non-NPL Remedial Action Site NPL State/Tribe-lead
Regional Discretion

Review number: 1 (first) **X** 2 (second) 3 (third) Other (specify) ____________

Triggering Action: Actual RA Start
Actual RA On-Site Construction at OU #1
Actual RA Start at OU# _____
Construction Completion
Previous Five-Year Review Report
Other (specify) Signing of ROD

Triggering action date (from WasteLAN): 09/30/1994

Due date (five years after triggering action date): 09/30/1999

EXECUTIVE SUMMARY

The Air Force Real Property Agency (AFRPA) has initiated a Five-Year Review for the former Pease Air Force (Pease AFB) in Portsmouth, New Hampshire. The review was conducted under the Air Force Center for Environmental Excellence (AFCEE) Contract No. F41624-03-D-8608, Task Order 58. The Air Force is preparing this Five-Year Review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). A Five-Year Review is required for the former Pease AFB, because the implemented remedies have resulted in hazardous substances remaining onsite at concentrations that do not allow unlimited use and unrestricted exposure. This document represents the second Five-Year Review for the former Pease AFB, and encompasses the period 1999 through 2004.

The overall purpose of this Five-Year Review is to determine if selected remedies are functioning as intended and are protective of human health and the environment. Methods, findings, and conclusions are documented in this *Five-Year Review Report*, which also identifies remaining issues and makes recommendations to attain or maintain protectiveness.

Each of the sites included in the Five-Year Review has a remedy in place. Therefore, technical assessments, as required under EPA guidance, were performed for each of the sites. These assessments consisted of answering the following questions:

- Question A: Is the remedy functioning as intended by the decision documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Sites included in the Five-Year Review were organized into three categories:

Category 1, Remedial Action Implemented

- Zone 1: Landfill 5
- Zone 2: Site 10 – Leaded Fuel Tank Sludge Area, Site 22 – Burn Area 1, Site 37 – Burn Area 2, and Site 43 – McIntyre Road Drum Disposal Area
- Zone 3: Site 32 – Building 113, Site 36 – Building 119
- Zone 3: Site 34 – Building 222, Site 39 – Building 227 (encompasses all Zone 3 sites, with the exception of source remediation at Sites 32/36)
- Zone 4: Landfill 6

- Zone 5: Site 8 – Fire Department Training Area
- Zone 7: Site 45 – Old Jet Engine Test Stand
- Zone 3: Site 73 – Building 234
- Zone 3: Site 49 – Building 22

Category 2, Long-Term Monitoring Only, Surface Water/Sediment, Remedial Actions Completed

- Zone 1: Pauls Brook
- Zone 3: McIntyre Brook
- Zone 1: Railway Ditch and Flagstone Brook

Category 3, Long-Term Monitoring Only, Surface Water/Sediment

- Zone 2: Peverly Drainage System
- Zone 4: Lower Grafton
- Zone 5: Knights Brook and Pickering Brook

Based on the review, remedies at all sites were found to be functioning as intended by the decision documents. While the remedy at Site 8 is functioning as intended, a review of the conceptual model for Site 8 also indicates that enhancement of the chosen remedy may be necessary to achieve Remedial Action Objectives (RAOs) in a timely manner. Several changes were noted in ARARs used to develop cleanup standards, as noted in the subsections of this *Five-Year Review Report*. No additional information was identified that would call into question the protectiveness of any of the individual remedies associated with the sites.

Several issues were identified during the Five-Year Review process. These issues are listed below, on a site-by-site basis. These issues will be addressed during routine site monitoring, data evaluation, and reporting activities, with the exception of the following:

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Actions: Affects Protectiveness (Y/N)	
				Current	Future
Perform hydraulic investigation at Site 49.	Air Force Real Property Agency (AFRPA)	EPA/ NHDES	Fall 2004	N	N
Perform remedial alternatives analysis for Site 8.	AFRPA	EPA/ NHDES	Fall 2004	N	N
Assess path forward to determine effectiveness of soil remedy at Zone 2.	AFRPA	EPA/ NHDES	Winter 2004/2005	N	N
Consider Site 49 and Site 32/36 vapor intrusion concerns.	AFRPA	EPA/ NHDES	Summer 2005	N	N

Category/Zone/Site	Identified Issue	Recommended Action(s)
Category 1, Remedial Action Implemented		
Zone 1: Landfill 5	Decrease in Arsenic Federal and State MCL from 50 µg/L to 10 µg/L	Note change in regulatory standard in future long-term monitoring reports; use Pease background value (23 µg/L).
Zone 2: Site 10, Site 22, Site 37, and Site 43	Decrease in Arsenic Federal and State MCL from 50 µg/L to 10 µg/L	Note change in regulatory standard in future long-term monitoring reports; use Pease background value (23 µg/L). Determine path forward to assess effectiveness of source area remediation.
	ARARs are now available for COCs that did not have ARAR-based cleanup goals in the ROD.	Note change in regulatory standards in future long-term monitoring reports.
Zone 3: Site 32 and Site 36	ARARs are now available for COCs that did not have ARAR-based treatment goals in the ROD.	Note change in regulatory standards in future long-term monitoring reports.
	Decrease in Arsenic Federal and State MCL from 50 µg/L to 10 µg/L.	Note change in regulatory standard in future long-term monitoring reports; use Pease background value (23 µg/L).
Zone 3: Site 34 and Site 39	An ARAR is now available for sec-butylbenzene (NHAGQS = 260 µg/L), which had a risk-based RG in the Zone 3 ROD Amendment of 7.3 µg/L	Note change in regulatory standard in future long-term monitoring reports.
Zone 4: Landfill 6	Decrease in Arsenic Federal and State MCL from 50 µg/L to 10 µg/L.	Note change in regulatory standard in future long-term monitoring reports; use Pease background value (23 µg/L)
	Lack of downward trend in groundwater concentrations of arsenic and sporadic detections of 2-butanone above the cleanup goal in the footprint of the former landfill.	Assess monitoring frequency.

Category/Zone/Site	Identified Issue	Recommended Action(s)
Category 1, Remedial Action Implemented		
Zone 5: Site 8	Mass removal has declined; LNAPL and contamination remaining within the saturated zone soils indicate extended timeframe to achieve groundwater RAOs.	Perform alternatives analysis to evaluate methods for enhanced contaminant removal.
	ARARs are now available for groundwater COCs that did not have ARARs at time of ROD.	Note change in regulatory standards in future long-term monitoring reports.
	Decrease in Arsenic Federal and State MCL from 50 µg/L to 10 µg/L.	Note change in regulatory standard in future long-term monitoring reports; use Pease background value (23 µg/L).
Zone 7: Site 45	None.	None.
Zone 3: Site 73	None.	None.
Zone 3: Site 49	Additional data needed to evaluate groundwater flow near and through the PRB.	Additional investigation to enhance understanding of groundwater flow and potential impacts on remedial progress.
Category 2, Long-Term Monitoring Only, Surface Water/Sediment, Remedial Actions Completed		
Zone 1: Pauls Brook	Inorganic concentrations in sediment do not adversely impact surface water, but remain above cleanup goals.	Reassess cleanup goals and frequency of monitoring efforts.
Zone 3: McIntyre Brook	None.	None.
Zone 1: Railway Ditch	The New Hampshire WQC listed as cleanup goals in the ROD are no longer current; only the WQC for nickel has decreased.	Note change in regulatory standard for nickel in future long-term monitoring reports.
Category 3, Long-Term Monitoring Only, Surface Water/Sediment		
Zone 2: Peverly Drainage System	Routine monitoring is only objective stated in ROD.	Evaluate appropriateness of cleanup goals.
Zone 4: Lower Grafton	None.	None.
Zone 5: Knights Brook and Pickering Brook	None.	None.

1.0 STATEMENT OF AUTHORITY AND PURPOSE

The Air Force Real Property Agency (AFRPA) has initiated a Five-Year Review for the former Pease Air Force (Pease AFB) in Portsmouth, New Hampshire. The review was conducted under the Air Force Center for Environmental Excellence (AFCEE) Contract No. F41624-03-D-8608, Task Order 58.

The overall purpose of this Five-Year Review is to determine if selected remedies are functioning as intended and are protective of human health and the environment. Methods, findings, and conclusions are documented in this *Five-Year Review Report*, which also identifies remaining issues and makes recommendations to attain or maintain protectiveness.

The Air Force is preparing this Five-Year Review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA §121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The EPA interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

A Five-Year Review is required for the former Pease AFB, because the implemented remedies have resulted in hazardous substances remaining onsite at concentrations that do not allow unlimited use and unrestricted exposure. This document represents the second Five-Year Review for the former Pease AFB, and encompasses the period 1999 through 2004. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) trigger date for the first Five-Year Review was September 30, 1994. The review was performed by Bechtel Environmental, Inc. and submitted on September 28, 1999 (Bechtel, 1999). This second Five-Year Review is required to be submitted to the United States Environmental Protection Agency (EPA) five years after the first (September 30, 2004).

2.0 REPORT ORGANIZATION

The *Comprehensive Five-Year Review Guidance* (EPA, 2001) indicates that the Five-Year Review Report should generally contain the following information:

- An introduction to the review;
- A site chronology and presentation of general site background information;
- A discussion of remedial actions that have taken place at the site;
- Description of progress since the last Five-Year Review, if applicable;
- A discussion of the Five-Year Review process;
- Technical assessment for each site;
- Identification of any issues arising from the review process;
- Recommendations and follow-up actions;
- Protectiveness statements; and
- Identification of the expected date of the next Five-Year Review.

This *Five-Year Review Report* generally follows the report template found in the 2001 EPA Guidance. However, because of the number of sites involved in the review, certain modifications were made to make the data more accessible to the reader. Certain general information was presented in introductory sections, and summary tables were created for each of the site categories for ease of reference. Tables and Figures are included in separate sections at the end of the document. The contents of each section of the *Five-Year Review Report* is as follows:

Section	Contents
1	Introduction to the *Five-Year Review Report*, stating the authority for, and purpose of, the review
2	Report Organization – Describes the organization of the *Five-Year Review Report*.
3	Methodology – Describes the overall process followed for the Five-Year Review.
4	Community Involvement – Describes the process for public involvement in the Five-Year Review process.

Section	Contents
5	Site Location and Description – Provides general background information for the former Pease AFB.
6	Report Summary – Provides summary maps and a summary table to assist the reader in locating specific site information in the *Five-Year Review Report.*
7	Category 1 Sites – Provides detailed background information on sites with remedial actions implemented, including descriptions of remedial actions, progress since the last five-year review, technical assessments for individual sites, recommendations, and protectiveness statements.
8	Category 2 Sites – Provides detailed information on surface water and sediment sites where remedial actions have been completed and long-term monitoring is currently being performed.
9	Category 3 Sites – Provides detailed information for surface water/sediment sites where only long-term monitoring was required and is being performed.

2.1 References

EPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

3.0 METHODOLOGY

3.1 APPLICABLE GUIDANCE

The *Comprehensive Five-Year Review Guidance* (EPA, 2001) was the primary document used to prepare this second *Five-Year Review Report* for the former Pease AFB. This guidance provides an overview of the review process and describes roles and responsibilities, components of the Five-Year Review process, and procedures for assessing the protectiveness of remedies.

3.2 SITE CATEGORIZATION

Under the Federal Facilities Agreement (FFA) for the former Pease AFB, eight Installation Restoration Program (IRP) zones were established. Multiple IRP sites are present within these zones. During the first Five-Year Review (Bechtel, 1999), three categories of sites were established on a hierarchy, based on status of remedy and IRP zone. The categories established in the first Five-Year Review included

- Category 1 - Remedial action implemented;
- Category 2 - Long-term monitoring only with remedial actions required and completed (surface water and sediment only);
- Category 3 - Long-term monitoring only, no remedial action requirement other than long-term monitoring (surface water and sediment only); and
- Category 4 - Sites without remedial actions implemented.

Within each category, sites were then grouped by IRP zone.

For this second *Five-Year Review Report*, the first three categories listed above were also used, for purposes of consistency. Since the time of the first Five-Year Review, all remedial actions under the IRP at the former Pease AFB have been implemented. Therefore, no sites remain in the fourth category.

3.3 SITE DATA

Numerous documents were reviewed for each site during the process of the Five-Year Review. These documents are cited as references at the end of individual sections of the report. These documents are maintained in the official Information Repository for the former Pease AFB, located at the MWH Field Office at Site 8, 20 Short Street, Pease Air Force Base, Portsmouth, New Hampshire.

3.4 INTERVIEWS AND SITE INSPECTIONS

Specific site interviews and inspections were not performed for this *Five-Year Review Report*. All sites included in the Five-Year Review are routinely inspected, and subject to ongoing monitoring and maintenance. Inspection logs included in annual reports, contractor and AFRPA personnel responsible for individual sites, and the onsite Operations and Maintenance (O&M) manager were consulted for specific information relative to the performance of individual remedies during preparation of this *Five-Year Review Report*.

3.5 TECHNICAL ASSESSMENTS

Each of the sites included in the Five-Year Review has a remedy in place. Therefore, technical assessments, as required under EPA guidance, were made for each of the sites in the three categories. These assessments consisted of answering the following questions:

- Question A: Is the remedy functioning as intended by the decision documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Section 4 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001) was used to develop appropriate responses to these questions. In general, the response to Question A was developed based on review of the Remedial Action Objectives (RAOs) set forth in the applicable Records of Decision (RODs), followed by assessment of current remedy performance data and progress toward cleanup goals. Question B was answered through an assessment of significant changes in standards and assumptions that were used at the time of remedy selection. Because most of the cleanup goals established for the sites are based on promulgated standards, this assessment generally focused on changes in those promulgated standards that have occurred since the last *Five-Year Review Report* (Bechtel, 1999) that would have an impact on remedy management. Where risk-based values were established as cleanup goals, the underlying toxicity data were also reviewed. Other information, such as potential changes in land use that could affect the protectiveness of the remedy was considered in responding to Question C.

3.6 REFERENCES

Bechtel, 1999. *Five-Year Review Report.* (September)

EPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

4.0 COMMUNITY INVOLVEMENT

The Information Repository for the former Pease AFB IRP is maintained at the MWH Field Office at Site 8, 20 Short Street, Portsmouth, New Hampshire. Periodic Restoration Advisory Board (RAB) meetings are held to notify the public of significant milestones in the environmental cleanup program at the former Pease AFB, as required under the FFA. No specific requirement is included for public involvement in the Five-Year Review process; however, a RAB meeting will be held during winter 2004/2005 to update the public on the current progress of cleanup efforts. The Five-Year Review will be addressed during this RAB meeting.

5.0 SITE LOCATION AND DESCRIPTION

The former Pease AFB is located in the Town of Newington and the City of Portsmouth, both in Rockingham County, New Hampshire. As shown in Figure 5-1, the former AFB occupies approximately 4,365 acres and is located on a peninsula in southeastern New Hampshire. The peninsula is bounded on the west and southwest by Great Bay, on the northwest by Little Bay, and on the north and northeast by the Piscataqua River.

At the onset of World War II, an airport at the former AFB location was used by the U.S. Navy. The U.S. Air Force assumed control of the site in 1951, and construction of the base was completed in 1956. Under Air Force command, the base served to maintain a combat-ready force capable of long-range bombardment operations. Over time various quantities of fuels, oils, lubricants, solvents, and protective coatings were used to support the mission, and as a result contaminants from these substances were released into the environment.

In 1976, the Department of Defense (DOD) initiated an assessment of the environmental contamination resulting from the past operation and disposal practices at all DOD facilities. In 1980, in response to the Resource Conservation and Recovery Act (RCRA), and in anticipation of the CERCLA, DOD issued a memorandum requiring identification of all hazardous waste disposal sites on DOD facilities. In 1983, a Phase I Problem Identification Search was conducted at the former Pease AFB to assess whether potential hazardous waste sites warranted further investigation. A pre-survey was submitted in 1984.

In December 1988, Pease AFB was selected as one of 86 military installations to be closed by the Secretary of Defense's Commission on Base Realignment and Closure (BRAC). The base was closed as an active installation in March 1991. The Air Force has transferred most of the former AFB to the Pease Development Authority (PDA) via quitclaim deed. The airfield is now a fully operational commercial airport. Other property is currently being used or developed for light commercial and industrial facilities. A portion of the base was transferred to the U.S. Department of Interior (DOI) for use as a national wildlife refuge and the Air Force retained 229 acres of the former base for use by the New Hampshire Air National Guard (NHANG).

In accordance with Executive Order 12580, the Air Force is designated the lead agency authority to conduct CERCLA cleanup activities at the former AFB and is responsible for all costs associated with the cleanup of contamination associated with past Air Force activities. The Air Force has been conducting an environmental cleanup program at the former AFB since 1983. This program is executed according to the guidelines of the Air Force IRP and the NHDES Underground Storage Tank (UST) program. The former AFB was proposed for addition to the National Priority List (NPL) in 1989 and was listed in 1990. On April 24, 1991 the Air Force, EPA, and NHDES signed a FFA establishing the protocols for conducting the environmental study and cleanup of the former AFB (MWH, 2003).

The FFA established eight IRP zones at Pease AFB for which separate remedial investigation and feasibility study (RI/FS) reports were prepared (See Figure 5-2). Zones 6 and 8 are located in the western portion of Pease AFB. These zones lie within parcels L and M, which is the area established by the DOI as the Great Bay National Wildlife Refuge, and do not require five-year review. The IRP zones and the sites included in this *Five-Year Review Report* are:

- Zone 1 is located in the eastern part of Pease AFB and includes the following IRP sites discussed in this report: Landfill 5, Railway Ditch and Pauls Brook.

- Zone 2 is located in the northwestern sector of Pease AFB and includes the following IRP sites discussed in this report: Site 10, Site 22, Site 37, Site 43, and Peverly Drainage System.

- Zone 3 encompasses the area of Pease AFB where most of the industrial shops and aircraft maintenance were located. Zone 3 includes the following IRP sites discussed in this report: Sites 32 and 36, Sites 34 and 39, Site 73, Site 49, and McIntyre Brook.

- Zone 4 is located on the southeastern margin of Pease AFB, southeast of Zone 3 and is relatively isolated from other IRP sites or zones. Zone 4 is bordered by Interstate 95 on the east and Buildings 94, 95, and 96 to the north. Zone 4 includes the following IRP sites discussed in this report: Landfill 6 and Lower Grafton Ditch.

- Zone 5 is located at the northern end of Pease AFB adjacent to the town of Newington and includes the following IRP sites discussed in this report: Site 8 and Knights Brook.

- Zone 7 is located in the southwestern portion of Pease AFB and includes the following IRP site discussed in this report: Site 45 (DOD, 1994).

Remedial Investigation (RI) and Feasibility Study (FS) Reports were prepared by 1994 (DOD, 1994). The RI/FS reports were utilized to develop RODs for the individual IRP zones . Source area RODs were also developed for several sites where interim remedial measures had been implemented. These sites were prioritized by the Air Force as posing significant risks to human health and the environment; they include Site 8, Site 32/36, Site 34 and Landfill 5. The RODs have become the controlling documents for site cleanup at the former Pease AFB.

5.1 References

DOD, 1994. *BRAC Cleanup Plan: Implementing President Clinton's Decision to Promote Early Reuse of Closing Bases by Expediting Environmental Cleanup*. Pease AFB, New Hampshire. (April)

MWH, 2003. *Zone 3 Record of Decision Amendment.* (December)

6.0 REPORT SUMMARY

This section is included in this *Five-Year Review Report* to aid the reader in locating information specific to a particular IRP Zone or site.

6.1 MAPS

Two reference figures are included in this section. Figure 6.1-1 illustrates the IRP Zones at the former Pease AFB. Figure 6.1-2 presents the locations of IRP Zones, individual IRP sites, and land use parcels identified at the Former Pease AFB.

6.2 SUMMARY TABLE

Table 6.2-1 is provided as a reference for locating information on specific sites that were included in the Five-Year Review. Table 6.2-1 includes the following information:

Site I.D. – Specifies IRP Zone and site identifier used in the first *Five-Year Report* (Bechtel, 1999).

Sites Included - Lists individual IRP sites included under the IRP Zone/site identifier in this *Five-Year Review Report*.

Site Categories – Indicates the category (1, 2, or 3) individual IRP sites were included in this *Five-Year Review Report*.

Location in Report – Indicates the report section where information for specific sites can be located.

6.3 REFERENCES

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

7.0 CATEGORY 1 SITES, REMEDIAL ACTION IMPLEMENTED

7.1 MAP

Category 1 sites addressed in this *Five-Year Review Report* include individual IRP sites located in Zone 1, Zone 2, Zone 3, Zone 4, Zone 5, and Zone 7. IRP site locations are illustrated in Figure 7.1-1.

7.2 DATA SUMMARY TABLE

Data summary tables have been included for each site category in this *Five-Year Review Report* to condense site information for easier reference. Table 7.2-1 summarizes information in this *Five-Year Review Report* for the sites included in Category 1. The columns in this table include the following information:

Site I.D. – The IRP Zone and site identifier used in the first *Five-Year Review Report* (Bechtel, 1999).

Sites Included – A listing of individual IRP sites included under the IRP Zone/site identifier in this *Five-Year Review Report*.

Site Chronology – A chronological listing of major documents associated with remedial actions performed at the sites.

Background – Description of site location and brief history of site activities that may have resulted in the release of hazardous substances to the environment.

Remedial Actions – Description of cleanup actions performed at the site.

Implementation of Recommendations from Last Five-Year Review – Summary of IRP actions performed during the reporting period (1999 – 2004).

Remarks – Primary document(s) governing remedial actions at the site.

7.3 FIVE-YEAR REVIEW OF CATEGORY 1 SITES

Individual subsections are provided to document the Five-Year Review process for each of the sites included in Category 1. These subsections are organized by IRP Zone/site identifier used in the first *Five Year Review Report* (Bechtel, 1999), and include the following:

- Background information: site description, initial responses, and basis for taking action;
- Remedial/removal action description: regulatory actions, RAOs, remedy description, and remedy implementation;
- Implementation of recommendations from last five year review;
- Technical assessment: answers to Questions A, B, and C in the *Comprehensive Five-Year Review Guidance* (EPA, 2001);
- Issues;
- Recommendations and follow-up actions;
- Protectiveness statements; and
- References.

7.4 ZONE 1, LANDFILL 5

7.4 1 Background

7.4.1.1 Site Description

Landfill 5 (LF-5) is located in Zone 1, in the northeastern portion of the former Pease AFB, as shown on Figure 7.4-1. The original landfill consisted of approximately 23 acres; consolidation of wastes during remedial action resulted in a capped area of approximately 18.5 acres. LF-5 is bordered by Arboretum Drive on the north, the Railway Ditch paralleling an abandoned railway bed on the east, Flagstone Brook to the west, the Paint Can Disposal Area (PCDA) on the south, and Site 13 to the southeast, as shown on Figure 7.4-2.

LF-5 reportedly was used between 1964 and 1975 as the primary base landfill, although some disposal occurred as late as 1979. Most of the material placed in the landfill consisted of municipal-type solid wastes generated from on-base housing, barracks, offices, dining facilities, etc. Industrial wastes were also reported to be disposed of in the landfill, including an unspecified quantity of waste oils, solvents, paints, paint strippers and thinners, pesticide containers, empty cans and drums, and sludge from the industrial waste treatment and base wastewater treatment facilities. Landfill operations reportedly included trench and fill methods involving excavation of overburden soils such that wastes were buried in direct contact with the underlying bedrock (Bechtel, 1999).

Before landfill closure, LF-5 sloped generally northward from a high of approximately 100-ft mean sea level (MSL) in the south to approximately 60-ft MSL to the north, an average slope of 4%. Prior to capping, bedrock was exposed in the central portion of the landfill (Bechtel, 1999).

The overburden deposits across Zone 1 include younger sediments, such as marsh deposits, and older deposits, such as glacial-marine deposits. The unconsolidated stratigraphic units identified at Pease AFB are fill, Upper Sand (US), Marine Clay, and Silt (MCS), Lower Sand (LS), and glacial till. One or more of these units may be absent at any particular location. The Upper Sand ranges in thickness from approximately 0.6 to 10 ft across Zone 1. The Lower Sand unit is not prevalent in Zone 1 due to the limited presence of the MCS unit across Zone 1. Glacial till is discontinuous across Zone 1 and is not present over portions of LF-5.

The topography of the bedrock surface across Zone 1 is accentuated by several prominent highs and one prominent valley, with up to 75 ft of relief zone-wide. A relatively large, broad bedrock high extended from the BFSA north toward LF-5, with an outcrop forming a small circular knob in central LF-5. The bedrock consists of rocks of the Eliot Formation, which is generally composed of interbedded phyllite, metagraywacke, and quartzite.

7.4.1.2 Initial Response

A drum disposal area was identified in the southeastern portion of the landfill area during the Stage 2 field effort. As a result, a drum removal operation was implemented as an interim remedial measure. This operation resulted in the excavation of an area of approximately 1.1 acres, with more than 1,000 intact, crushed and partially crushed 55-gallon drums and 5 gallon cans being removed. Additionally seven tanks ranging in size from 250 to 5,000 gallons were removed (Weston, 1992).

7.4.1.3 Basis for Taking Action

Remedial Investigation (RI) Reports for Landfill 5 and Zone 1 (Weston, 1992 and Weston, 1993b) were completed in April 1992 and October 1993, respectively. The presence of buried wastes and contamination in soil, groundwater, surface water, and sediment in the areas surrounding the landfill was documented in the *IRP Stage 3C Landfill 5 Remedial Investigation* (Weston 1992). The information included in the LF-5 RI was confirmed in the Zone 1 RI (Bechtel, 1999).

The RI Reports identified the following:

- Three VOCs whose concentrations exceeded the maximum contaminant level (MCLs) were identified in the groundwater: tetrachloroethene, trichloroethene, and benzene. Additionally, concentrations of arsenic, beryllium, chromium, and nickel exceeded MCLs.

- The hydraulic gradients across Landfill 5 indicated that groundwater flows towards Flagstone Brook and the Railway Ditch. These drainageways also receive surface water from Landfill 5. VOCs were detected in surface water in Flagstone Brook and the Railway Ditch which are located west and east of Landfill 5 respectively (Note: Surface water and sediment associated with LF-5 are addressed under Section 8.6 of this *Five-Year Review Report.*)

- Pesticides were detected at low concentrations in soils across the landfill. Polynuclear aromatic hydrocarbons (PAHs) and metals were detected at elevated levels in soil from the drum removal area near the southeastern edge of the landfill and in soils from the northern trench area. PAHs and pesticides were detected in sediments in Flagstone Brook and the Railway Ditch. Elevated metals concentrations were detected in the Railway Ditch sediments.

7.4.2 REMEDIAL/REMOVAL ACTIONS

The following subsections describe regulatory actions and remedial actions performed at Landfill 5.

7.4.2.1 Regulatory Actions

Controlling documents for ongoing remedial actions at LF-5 include the following:

Landfill 5 ROD (1993): The *Record of Decision for a Source Area Remedial Action at Landfill 5* (Weston, 1993a) outlined the selection of a source control remedy which included partial excavation and installation of a barrier cap.

Zone 1 ROD (1995): The Zone 1 RI/FS focused on a number of sites and contaminated media in the zone, including Landfills 2 and 4, the Paint Can Disposal Area, and groundwater at Landfill 5. Evaluation of the risk assessment results and other data from the RI/FS resulted in the focusing of the Zone 1 response action on contaminated groundwater associated with Landfill 5.

7.4.2.2 Remedial Action Objectives

The following RAOs were identified in the *LF-5 ROD* (Weston, 1993a):

- Prevent or minimize risks to ecological receptors resulting from exposure to contaminated sediment in the Railway Ditch and associated wetlands or to contaminated soil and debris associated with LF-5;
- Prevent or minimize risks to humans resulting from exposure to contaminated soil or debris associated with LF-5; and
- Minimize further migration of contaminants from the LF-5 source area into the groundwater or surface water (Bechtel, 1999).

The RAOs identified in the *Zone 1 ROD* (Weston, 1995) include the following:

- Protect human receptors from exposure to contaminated groundwater that may present unacceptable health risks; and,

- Comply with chemical specific applicable or relevant and appropriate requirements (ARARs) and/or attain background levels for specific contaminants in groundwater. Table 7.4-1 lists the LF-5 groundwater clean-up goals.

7.4.2.3 Remedy Description

The *Landfill 5 ROD* (Weston, 1993a) specified a *source control remedy* having the following components:

- Excavating and consolidation/disposal of Railway Ditch sediments into Landfill 5 that contained contaminants at concentrations exceeding site-specific cleanup goals;
- Excavating of soil and debris from Landfill 2 and Landfill 4 with consolidation/disposal into Landfill 5;
- Excavating of soil and landfill debris from Landfill 5 that would be in contact with groundwater (after placement of excavated material from other sites and capping); excavated areas would be backfilled with clean fill to a level 2 ft above water table (as measured after capping);
- Re-grading and capping of Landfill 5 with a composite barrier cap designed to meet RCRA Subtitle C cap performance standards; and,
- Conducting long-term monitoring (including 5-year reviews) and placement of institutional controls (deed restrictions) to restrict future activities on the capped area.

The *Zone 1 ROD* (Weston, 1995) specified a *management of migration remedy* to address dissolved-phase contamination at Landfill 5, including contamination within the Landfill 5 boundary and that which had migrated beyond its footprint. Specific components of the action included:

- Natural attenuation and biodegradation of contaminated groundwater in Zone 1;
- Placement of deed restrictions on future use of groundwater in Zone 1 in the vicinity of the Landfill 5 source area;
- Establishment of a Groundwater Management Zone (GMZ) in Zone 1 in the vicinity of the Landfill 5 source area; and,

- Long-term environmental monitoring in the zone to allow the continued evaluation of the magnitude of contamination including groundwater, surface water and sediment sampling and analysis.

7.4.2.4 Remedy Implementation

Excavation and relocation of landfill debris, soils, and sediments from LF-2, LF-4, and LF-5 and the adjacent Railway Ditch to LF-5 were performed between December 1993 and June 1995. Additionally, a lined sedimentation basin was constructed to receive groundwater, site runoff, and water pumped from the excavation. Relocated waste was consolidated above the predicted seasonal high groundwater level. An intermediate cap was constructed to cover debris as a precursor to Phase II cap construction (IT, 1995).

During the second phase of the Landfill 5 remedial action, additional debris and waste soils from LF-6, the UST Flightline area, Site 34, and Site 72 were consolidated into LF-5. Following consolidation, LF-5 was capped with a composite-barrier-type final cover system to minimize water infiltration and prevent contact between landfill debris and either human or ecological receptors. After completion of capping, piezometers, landfill gas monitoring probes and vents, and survey monuments were installed as specified in the design. This work was completed between May 1995 and July 1996 (Bechtel, 1996).

Inspections and long-term groundwater monitoring are ongoing components of the LF-5 remedy. In accordance with the current *Post Closure Maintenance and Monitoring Plan Revision 3* (PCMMP) (MWH, 2003), nine GMZ perimeter wells are sampled once per year in the spring and five interior GMZ wells are sampled every other year in the spring. Other samples taken yearly in the spring include twenty-five gas samples from vents and probes at LF-5 as well as six surface water and three sediment samples from Flagstone Brook and the Railway Ditch. Surface water and sediment samples are further addressed in Section 8.6. Visual inspection of the landfill is performed concurrently with the yearly sampling and includes identification of any deficiencies with the cap, drainage systems and sedimentation basin.

The most recent sampling data from LF-5 groundwater indicates that all site-specific COCs are presently below their respective clean-up goals in all monitored locations (MWH, 2004).

Results from visual inspections indicate that the facility was both properly designed and constructed. All components of the closure action are functioning as intended. The site and surrounding areas have stabilized and vegetation is well established following the extensive earthwork associated with the closure.

LUC/ICs are in place for Landfill 5 in the form of restrictions in the deed, which was executed between the Air Force and the current owners of the property (PDA and New Hampshire Air National Guard). The deed implemented several Land Use Control and Institutional Control (LUC/IC) measures. These include a Groundwater Management Zone (GMZ) prohibiting use of groundwater and a Use Restriction Zone (URZ) prohibiting both residential use and establishment of child care facilities, playgrounds or elementary/secondary schools. The deed established the Landfill 5 GMZ as an Area of Special Notice (ASN) requiring concurrence from the Air Force for any development within the GMZ and specifically prohibits any activity that could disturb ongoing remedies. The ongoing use of the property conforms to the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified. No violations of the LUC/ICs have been identified.

7.4.3 Implementation of Recommendations from Last Five-Year Review

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedy at LF-5 remained protective of human health and the environment. Recommendations in the *Five-Year Review Report* included continued annual evaluation of environmental monitoring data and assessment of opportunities to refine monitoring activities. Annual long-term monitoring has been performed since 1999, and the results of this monitoring are presented in the following documents:

- *Landfill 5 1999/2000 Annual Report.* Bechtel, 2000 (October).
- *Landfill 5 2000/2001 Annual Report.* MWH, 2001 (December).
- *Landfill 5 2002 Annual Report.* MWH, 2002 (December)
- *Landfill and Construction Rubble Dump 2003 Annual Report.* MWH, 2004 (March)

Optimization of long-term monitoring is documented in the following:

- *Landfill 5 Post Closure Maintenance and Monitoring Plan.* Bechtel, 2001 (February).
- *Landfill 5 Post Closure Maintenance and Monitoring Plan, Revision 3.* MWH, 2003 (July).

Based on remedy performance, long-term monitoring was adjusted as follows:

- Annual groundwater monitoring of VOCs in the source area reduced to biannual (beginning 2001).
- Groundwater monitoring for SVOCs, pesticides, total metals, and intrinsic remediation (IR) parameters in source area discontinued (beginning 2001).
- Groundwater monitoring at GMZ reduced (number and frequency of analyses) (beginning 2003).
- Groundwater monitoring for IR parameters discontinued at the site (beginning 2003).
- Frequency of landfill gas and air monitoring reduced (beginning 2002).

7.4.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001).

7.4.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of documents, ARARs, risk assumptions, and the results of annual monitoring and inspections indicates that the remedy is functioning as intended. The excavation and capping have served to isolate landfill wastes and reduce infiltration. The cover is maintained and is functioning as designed, based on groundwater elevations and decreasing trends in groundwater contaminant concentrations. The most recent sampling data from LF-5 groundwater monitoring wells indicate that all site-specific COCs are presently below their respective clean-up goals in all monitored locations, with the exception of total manganese, which remains above background levels in two overburden monitoring locations. These locations are cross-gradient of LF-5 and downgradient of nearby Site 13 and are likely not the result of LF-5 activities. LUC/ICs, including the GMZ, are in place, remain protective and are functioning as intended. There have been no exceedances of cleanup goals at the GMZ boundary. The gas vents are functioning as designed to collect and discharge landfill gases; and ambient air quality is not being adversely impacted by landfill gas discharge.

7.4.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards :</u> The Landfill 5 ROD identified cleanup goals for soil that were used to guide excavation, consolidation, and capping of landfill wastes. These soil cleanup goals do not govern post-closure care of the landfill. Groundwater cleanup standards at LF-5 were based on background (inorganics only) Safe Drinking Water Act MCLs, New Hampshire Drinking Water Quality Standards (Env-Ws 316, 317, and 318), New Hampshire Ambient Groundwater Quality Standards (Env-Wm 1403), and New Hampshire Department of Health and Human Services, Division of Public Health Services, Bureau of Health Risk Assessment (NHDPHS) drinking water standards. The standards impacting LF-5 remain current, with the exception noted below:

<u>Arsenic:</u> On January 22, 2001, EPA adopted a new Federal MCL for arsenic (changed from 50 μg/L to 10 μg/L; effective February 22, 2002). Similarly, the New Hampshire MCL was reduced from 50 μg/L to 10 μg/L on February 8, 2002. Background concentrations of arsenic at the former Pease AFB are documented to be 23 μg/L (See Section 7.4.5 below). Therefore, the new MCLs for arsenic are less than natural background at the former Pease AFB.

<u>1,1-Dichloroethane:</u> The *Zone 1 ROD* indicates a risk-based cleanup goal of 8.1 μg/L for 1,1-Dichloroethane. The current NHAGQS standard is 81 μg/L. Standards for surface water and sediment at Landfill 5 are discussed in Section 8.6.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: ARARs, risk-based concentrations (1,1-DCA only), and background values were used to establish groundwater cleanup goals in Zone 1. An ARAR (NHAGQS) is now available for 1,1-DCA (81 μg/L). Therefore, changes in toxicity values or other contaminant characteristics do not affect the protectiveness of the remedy.

Changes in Risk Assessment Methods: The human health risk assessments were conducted following USEPA and EPA Region 1 guidance. There has not been any significant change in EPA guidance which could result in significant revisions to the cleanup goals. Based on this review, the health protectiveness of the original cleanup goals would not be expected to change, based on the use of ARARs for establishment of cleanup goals in groundwater. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessments that were conducted are consistent are consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: Implementation of the remedy at Landfill 5 is currently achieving the RAOs specified in the applicable RODs.

7.4.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.4.4.4 Technical Assessment Summary

As is described in Section 7.4.4.2 above, the remedy is functioning as intended at Landfill 5 to protect human health and the environment. While minor changes in ARARs have affected groundwater cleanup levels, these changes have not impacted the protectiveness of the remedy, based on site-specific groundwater monitoring data. No changes in exposure pathways are affecting the protectiveness of the remedy. The remedy is currently achieving RAOs. LUC/ICs are in place and performing as expected. No other information has come to light that would call into question the protectiveness of the remedy.

7.4.5 Issues

Issues identified for LF-5 include:

- Decrease in Arsenic Federal and State MCL from 50 μg/L to 10 μg/L.

This issue does not impact the protectiveness of the groundwater remedy at Landfill 5. Current arsenic concentrations are less than 23 μg/L, which represents the maximum background value for the former Pease AFB (*Background Values for Soil, Groundwater, Surface Water, and Sediment at Pease Air Force Base.* Weston, 1993c [February]).

7.4.6 Recommendations and Follow-up Actions

Remedial measures at Landfill 5 remain protective of human health and the environment. Annual evaluation of environmental monitoring results should continue, with data analysis including identification of opportunities to streamline monitoring and reporting. The change in the federal and state MCL for arsenic should be noted in future long-term monitoring reports.

7.4.7 Protectiveness Statement

Because of the relocation of the landfill debris above the seasonally high groundwater elevation, the installation of the composite barrier cap, the establishment/maintenance of the GMZ and other ICs, attainment of groundwater cleanup goals, and routine maintenance and monitoring, the remedial action is protective of human health and the environment.

7.4.8 References

Air Force Base Conversion Agency (AFBCA), 2002. *Draft Final Land Use Control/Institutional Control Management Plan*. Pease Air Force Base. (October)

Bechtel, 1996. *Landfill 5 Remedial Action Report.* (September)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000. *Landfill 5 1999/2000 Annual Report.* (October)

Bechtel, 2001. *Landfill 5 Post Closure Maintenance and Monitoring Plan.* (February).

EPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

IT, 1995. *Draft Final Report, Excavation and Relocation of Waste, Soil, and Sediments, Landfills 2, 4, and 5, Pease AFB, New Hampshire.* (October)

MWH, 2001. *Landfill 5 2000/2001 Annual Report.* (December).

MWH, 2002. *Landfill 5 2002 Annual Report.* (December)

MWH, 2003. *Landfill 5, Post Closure Maintenance and Monitoring Plan, Revision 3.* (July)

MWH, 2004. *Landfill and Construction Rubble Dump 2003 Annual Report.* (March)

Weston, 1992. *IRP Stage 3C Landfill 5 Remedial Investigation (Draft Final).* (April)

Weston, 1993a. *Record of Decision for a Source Area Remedial Action at Landfill 5..* (September)

Weston, 1993b. *Zone 1 Remedial Investigation.* (October)

Weston, 1993c. *Background Values for Soil, Groundwater, Surface Water, and Sediment at Pease Air Force Base.* (February)

Weston, 1995. *Zone 1 Record of Decision.* (July)

7.5 ZONE 2

7.5.1 Background

7.5.1.1 Site Description

Zone 2 is located in the northwestern portion of the former Pease AFB, as shown in Figure 7.5-1. Zone 2 contains six sites investigated under the Air Force's IRP. The sites include: Site 1 (Landfill 1 or LF-1), Site 7 (Fire Department Training Area 1 or FDTA-1), Site 10 (Leaded Fuel Tank Sludge Area or LFTS), Site 22 (Burn Area 1 or BA-1), Site 37 (Burn Area 2 or BA-2), and Site 43 (McIntyre Road Drum Disposal Area or MRDDA). Figure 7.5-2 illustrates the location of each site in Zone 2.

The *Zone 2 Record of Decision* (Weston, 1995) specified no further action for LF-1 under CERCLA. Therefore, LF-1 is not addressed further in this review document. The Zone 2 Zone-Wide Long-Term Monitoring Unit addresses long-term monitoring associated with Site 22, Site 37, Site 10, and Site 43. A description of each site is provided below.

<u>Site 10</u>

Site 10 consists of two separate areas on the eastern and western sides of Nottingham Road, both within approximately 300 ft of Site 22. From the late 1950s to 1978, Site 10 was used for disposal of sludge obtained from leaded aviation gasoline tank cleaning operations conducted at the on-base Bulk Fuel Storage Area (BFSA). An estimated 350 gallons of sludge containing water, rust, residual fuels, fuel sludge, and residue from sand blasting tank interiors was generated during the approximately 20-year disposal period. Historic aerial photographs indicated that drum disposal may have also occurred at Site 10 to the south-southeast of the current site boundaries (MWH, 2004).

<u>Site 22</u>

Site 22 is located in the central portion of Zone 2 and is the main source of contamination in Zone 2. Site 22 has been reported to have been used as a fire training area and a site for burning spent fuel and solvents between 1954 and 1976. The primary contaminant source was found to consist of two circular areas characterized by blackened or stained surface soil with little or no vegetation. Relatively flat, this site has no obvious surface drainageways, so precipitation rapidly infiltrates the sandy subsoils (MWH, 2004).

Site 37

Site 37 is located southwest of Site 10, adjacent to the eastern side of McIntyre Road. Site 37 covers approximately 3.4 wooded acres surrounding roughly circular areas characterized by blackened surface soil with little or no vegetation. Site 37 is a suspected former fire training area or waste solvent burn area. Although the exact period of use is not certain, it is estimated that fire training or waste solvent burn activities commenced between 1954 and 1960 and ended before 1976, based on aerial photographs (MWH, 2004).

Site 43

Site 43, the McIntyre Road Drum Disposal Area (MRDDA) is located west of McIntyre Road and south of Nottingham Road In Zone 2. It is generally open, with a thick growth of low brush and small trees covering the northern quarter of the Site. Elsewhere the ground surface is generally devoid of topsoil and is covered with sand and gravel. The area is generally flat along the side bordering McIntyre Road, however the southwestern edge has a steep embankment with a topographic relief of approximately 30 feet. Little information is available concerning the history and use of MRDDA, although the area shows signs of past earthmoving activities. An elongated ridge approximately four feet high and approximately 50 feet by 425 feet in size was parallel to McIntyre Road. A cluster of 55-gallon drums and 5-gallon cans was partially exposed at the surface of the ridge; consequently the ridge and adjacent areas were suspected to be locations of historic subsurface disposal. Investigation did not find evidence of subsurface disposal, and it was concluded that the MRDDA was not a contaminant source area (Bechtel, 1999a).

The native overburden deposits in Zone 2 consist of the upper sand (US), which is underlain successively by the marine clay and silt (MCS), lower sand (LS), and glacial till (GT). Fill material overlies the US at some locations, primarily at LF-1, Site 43, and areas of the zone bordering the runway. One or more of these units may be absent at any particular location. The thickness of the overburden is thin to absent to the west and southwest of Site 43 and the maximum overburden thickness is along the eastern border of the zone, where the bedrock surface drops sharply (MWH, 2004).

The bedrock in Zone 2 consists primarily of the Eliot Formation, composed of phyllite, metagraywacke, and quartzite. In general, bedding strikes northeast with steep dips to the northwest. Open fractures are abundant in shallow bedrock and open fracture densities decrease significantly in deeper bedrock (MWH, 2004).

Groundwater occurs in both overburden and bedrock underlying Zone 2. The major water-bearing units are the US, LS, and bedrock. The water table is typically present in the US unit during periods of high water levels (spring) and the LS and MCS units during periods of low water levels (fall/winter). The MCS unit appears to be a confining layer in some areas but is absent in other areas. The relatively flat topographic high in the central portion of Zone 2, typically coarse and permeable surface soil, and the lack of surface drainage features indicate that some groundwater recharge does occur across the site. To the north and west of the topographic high, the ground surface slopes toward the Peverly Ponds. Much of the low-lying portion of Zone 2 consists of ponds and wetlands, which are points of groundwater discharge (MWH, 2004).

7.5.1.2 Initial Response

No remedial action was performed within Zone 2 prior to the finalization of the *Zone 2 ROD* (Weston, 1995).

7.5.1.3 Basis for Taking Action

Sites in Zone 2 were investigated during multiple investigations under the IRP (Stages 1, 2, and 4) between 1984 and 1993 (Weston, 1995). Aromatic hydrocarbons in the form of benzene, toluene, ethylbenzene, and xylenes (BTEX) were found to be the primary constituents of concern (COC) in the overburden groundwater, while benzene was the primary COC in bedrock groundwater. Other organic contaminants, including ethylene dibromide, naphthalene, 1,2,4-trimethylbenzene (1,2,4-TMB), and trichloroethene (TCE), were detected at scattered locations across Zone 2 at concentrations exceeding the New Hampshire Ambient Groundwater Quality Standards (NHAGQS). These contaminants appear to be more prevalent near known source areas; however, these source areas do not appear to have generated any spatially significant dissolved phase plumes. Other organics, including halogenated hydrocarbons and polynuclear aromatic hydrocarbons, were detected at concentrations below the NHAGQS. Low concentrations of metals (arsenic, manganese, and lead) have also been detected with isolated exceedances of the NHAGQS.

The source areas of concern within Zone 2 consist of contaminated soils at Sites 22, 37, and 10. While the soil in the unsaturated zone at these locations contained only negligible levels of contamination, the saturated soils in these areas were found to have relatively significant amounts of residual contamination. The COCs include BTEX and total petroleum hydrocarbons (TPHs). The highest levels of contamination typically occur at the US/MCS interface (Weston, 1995).

7.5.2 Remedial/Removal Actions

The following subsections describe regulatory actions and remedial actions at Zone 2.

7.5.2.1 Regulatory Actions

The *Zone 2 Record of Decision* (Weston, 1995) documented the selection of a remedy that included soil vapor extraction/air sparging (SVE/AS) (Site 22 only), long-term monitoring, natural attenuation and institutional controls.

7.5.2.2 Remedial Action Objectives

The baseline risk assessment completed as part of the RI process for Zone 2 identified adverse human health risks for future groundwater users in areas associated with the contaminant plumes at Sites 22, 10, and 37. Minimal ecological risks were identified for soils at LF-1 and BA-2 and surface water and sediment in the Peverly Brook drainage system.

The Zone 2 ROD identified RAOs that defined the scope and purpose of the cleanup action needed to mitigate the potential threats to human health and the environment identified in the Baseline Risk Assessment. The following site-specific RAOs were developed for Zone 2 (Bechtel, 1999a):

Soils

- Site 10 – No RAOs were established for soils because there were no exceedances;
- Site 22 – Remove LNAPL and residual product from Site 22 soil.
- Site 37 – No RAOs were established for soil because the extent of contamination was limited.

Groundwater

- Protect human receptors from contaminated groundwater that may present an unacceptable health risk (total cancer risk greater than 10^{-4} to 10^{-6} or a hazard index of greater than 1);
- Comply with chemical-specific, regulatory-based remedial objectives (ROs);
- Prevent contaminated groundwater from affecting surface water quality;
- Protect against potential leaching of soil contaminants from Site 22 soils to groundwater at levels that could cause exceedances of groundwater ROs; and
- Surface water, sediment, and biota – Monitoring of surface water and sediment quality over time in Upper and Lower Peverly and Bass ponds (Note: Surface water and sediment monitoring are addressed in Sections 8 and 9 of this *Five-Year Review Report*).

7.5.2.3 Remedy Description

The remedial alternative selected by the ROD included the following (Weston, 1995):

- In situ SVE/air sparging treatment of BA-1 [Site 22] source area LNAPL and residual LNAPL (enhanced by injection of air below the water table into the MCS) and treatment of extracted soil vapor for removal of VOCs.
- Establishment of institutional controls restricting the future use of Zone 2 groundwater, including a GMZ, and performance of long-term GMZ monitoring.
- Natural attenuation (which may include natural biodegradation) of residual groundwater contamination after excavation, air sparging, and SVE.
- Monitoring of surface water, sediment and fish tissue.

Cleanup goals for Zone 2 groundwater were specified in the *Zone 2 ROD* (Weston, 1995). These cleanup goals are listed in Table 7.5-1. No specific cleanup goals were established for soil.

7.5.2.4 Remedy Implementation

The Site 22 remedial system for source soils was constructed in late 1996 and early 1997, and began operation in May 1997. The system is divided into two areas: the primary area which includes the western portion of the Site, and the expansion area which includes the eastern portion of the Site. The original design called for treatment in the primary area only. Subsequent investigations indicated that soil remediation was necessary in additional areas, and the system was expanded to meet this need. However, AS is limited in the expansion area, and SVE is the primary form of treatment in the expansion area. The in situ AS system consists of 10 manifolds (S1-S10) piped to a total of 70 vertical AS wells. Fifty-two AS wells are located in the primary area, and 18 AS wells are in the expansion area. The AS system also consists of a blower assembly, heat exchanger, manifold, and ancillary items, including flow control valves, pressure, temperature, and flow indicators, and sample ports. The primary area and expansion area SVE systems consist of the blower assembly, knockout tank, manifold, and ancillary items, including flow control valves, temperature, vacuum, and flow indicators, and sample ports. The primary area blower system is piped above grade to 7 SVE well manifolds (P1-P7), which contain a total of 34 SVE wells. The expansion area blower system was piped above grade to 10 SVE well manifolds (E1-E10) containing a total of 61 SVE wells.

In situ SVE/AS of the source area for removal of LNAPL and residual product from the soil and treatment of extracted soil vapor for removal of VOCs was the active remedy for Site 22 from May 1997 through 2000 (except for the winter months) and for portions of 2002.

It was successfully demonstrated to the EPA that the system was operating properly and successfully (OPS) in April 2000, allowing for the deed transfer of the property, which was undergoing long-term remedial action prior to all environmental cleanup objectives being accomplished.

EPA and NHDES concurred with the 2000 Zone 2 Annual Report proposal to not operate the SVE/AS system during 2001 while continuing to monitor groundwater quality to evaluate the effects of not operating the system. Since the SVE/AS system has been offline, the Air Force has implemented soil confirmation sampling to assess the remaining amount of soil contamination that could continue to pose a threat to Zone 2 groundwater quality. Upon the review of confirmation soil sampling data, the SVE/AS system was restarted on September 23, 2002 (select laterals only) to determine the viability of removing recalcitrant soil contaminants from portions of the site. The system was shut down on October 23, 2003 and has not restarted since then. The Air Force and regulators are currently in discussions to determine how to more confidently evaluate the remaining amount of contamination that could pose a continued threat to groundwater before a definitive decision is made concerning the status of the Site 22 soil remedy.

Long-term monitoring for the Zone 2 GMZ and to assess the progress of natural attenuation is ongoing. Monitoring at Site 22 indicates the SVE/AS has been effective in remediating the soils within the Site 22 source area. Remaining wells at Site 22 that have contamination greater than the cleanup goals are 7771 (point of compliance), 7935 (source area), 545, and 5124 (located northeast of the treatment area between Site 22 and Site 10) (Figure 7.5-3).

Long-term monitoring for Site 10 is ongoing. The Site 10 benzene contaminant plume currently includes wells 5112 and 5062. LS well 5059 has shown a decreasing trend in benzene concentration since 1997 to below cleanup standards, while the benzene concentration in LS well 5112, located downgradient of well 5059, has stabilized. Benzene concentrations detected in the GMZ boundary well 7771, directly downgradient of 5112 (approximately 1,050 ft), exceeded the NHAGQS in 2003 (6 μg/L vs. NHAGQS of 5 μg/L). (Note: Benzene concentrations greater than 5 μg/L have not historically been reported in this well, and an increasing trend in concentration is not present.)

Volatile groundwater contamination at Site 37 is isolated, observed only at wells 5125. Benzene continues to be detected above the 5 μg/L clean up goal at monitoring well 6114 (MWH, 2004). Groundwater clean up goals at Zone 2 are summarized in Table 7.5-1.

The *Site 22 System Start-up and System Long-Term Monitoring Plan* (Bechtel, 1997b) was revised by the *Zone 2 Long-Term Monitoring Plan Revision 1* (Bechtel, 1999b), and then the *Zone 2 Long-Term Monitoring Plan Revision 2* (MWH, 2001). Each long-term monitoring plan revision reduced the number of monitoring wells and list of analytes to be reported as well as the frequency of collection across the zone. The *Zone 2 LTMP Revision 2* (MWH, 2001) requires that a total of 32 locations will be sampled. Parameters to be monitored include Zone 2 COC and intrinsic remediation parameters, as necessary. Additionally, the collection of water levels is also required on a semi-annual basis to assess groundwater elevations and flow directions.

The most recent contaminant concentrations detected in groundwater (Figure 7.5-3) are generally consistent or slightly decreasing when compared to the previous years' data. Therefore, no rebounding effects are being demonstrated in the groundwater that would indicate a negative impact from the shutdown of the SVE/AS system.

LUC/ICs are in place for Zone 2 in the form of restrictions communicated in the deed which was executed between the Air Force and the current owners of various sections of Zone 2 (PDA, U.S. Fish and Wildlife Service, Town of Newington [McIntyre Road only]). The deed implemented several LUC/IC measures. These include a GMZ prohibiting use of groundwater and a URZ prohibiting both residential use and establishment of child care facilities, playgrounds or elementary/secondary schools. The deed established the Zone 2 GMZ as an ASN, requiring concurrence from the Air Force for any development within the GMZ and specifically prohibits any activity that could disturb ongoing remedies. The ongoing use of the property conforms with the restrictions of the URZ, and property use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.5.3 Implementation of Recommendations From Previous Five-Year Review

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedies for Zone 2 and Site 22 remained protective of human health and the environment. The following recommendations were included in the *Five-Year Review* (Bechtel, 1999a):

- Continued implementation of the remedial actions at Zone 2 in accordance with EPA and NDHES-approved plans governing system operation, maintenance, and monitoring.
- Annual evaluation of system operation and environmental monitoring and evaluation of opportunities for optimization.
- Evaluation of system performance to identify realistic endpoints for the remediation based on reduced system performance/effectiveness.
- Evaluation of progress toward meeting groundwater cleanup goals.

Annual evaluation of system performance, progress toward cleanup goals, and optimization efforts were documented in the following:

- *Zone 2 Operating Properly and Successfully Report.* Bechtel, 2000 (April).
- *Zone 2 2000 Annual Report.* Montgomery Watson, 2001 (March).
- *Zone 2 2002 Annual Report and Groundwater Evaluation.* MWH, 2003 (May).
- *Zone 2 2003 Annual Report and Groundwater Evaluation.* MWH, 2004 (June).

Optimization of long-term monitoring is documented in the following:

- *Zone 2 Long-Term Monitoring Plan Revision 1* Bechtel, 1999.
- *Zone 2 Long-Term Monitoring Plan, Revision 2.* MWH, 2001 (November).

7.5.4 Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

7.5.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of documents, ARARs, risk assumptions, and the results of annual system and groundwater monitoring indicates that the remedy is functioning as intended, as described below.

- Site 22 Soils. LNAPL and residual product are no longer observed in Site 22 soils.

- LUC/ICs are in place, remain protective and are functioning as intended.

- Natural attenuation of bedrock and overburden groundwater contamination - Natural biodegradation of COCs in groundwater is occurring, and progress is being monitored.

- Surface water and sediment – Monitoring of surface water and sediment quality over time is being performed in Upper and Lower Peverly and Bass ponds (Note: Surface water and sediment monitoring are addressed in Sections 8 and 9 of this *Five-Year Review Report*).

7.5.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards:

Groundwater cleanup goals in the *Zone 2 ROD* were based on ARARs, except where ARARs were not available. Risk-based cleanup goals were established for isopropylbenzene, 2-methylnaphthalene, sec-butylbenzene and 1,2,4-trimethylbenzene, and background conditions were used to establish the cleanup goal for manganese. Of the sixteen constituents for which cleanup goals were established, ARARs were used for benzene, bis(2-ethylhexyl) phthalate, 1,2-dibromoethane, ethylbenzene, methyl isobutyl ketone, napthalene, toluene, trichloroethene, arsenic, cadmium and lead. ARARs included Federal Safe Drinking Water Act MCLs, and the New Hampshire Ambient Groundwater Quality Standards (Env-Wm 1410.05).

Since the last Five-Year Review, NHAGQS have been established for constituents in the Zone 2 ROD that had risk-based cleanup goals: isopropylbenzene, 2-methylnaphthalene, sec-butylbenzene and 1,2,4-trimethylbenzene. The established NHAGQS (280 µg/L, 280 µg/L, 260 µg/L and 330 µg/L, respectively) are significantly higher than the risk-based levels included in the *Zone 2 ROD* (see table below). Also, the NHAGQS for methyl isobutyl ketone was increased from 350 µg/L to 2,000 µg/L.

Constituent	ROD Risk-Based Cleanup Goal (µg/L)	Current NHAGQS (µg/L)
Isopropylbenzene	88.1	280
2-methylnaphthalene	13.4	280
sec-butylbenzene	7.3	260
1,2,4-trimethylbenzene	19.8	330

Current groundwater concentrations throughout Zone 2 meet the new ARARs for isopropylbenzene, 2-methylnaphthalene, and sec-butylbenzene.

On January 22, 2001, EPA adopted a new Federal MCL for arsenic (changed from 50 µg/L to 10 µg/L). Similarly, the New Hampshire MCL was reduced from 50 µg/L to 10 µg/L on February 8, 2002. Background concentrations of arsenic at the former Pease AFB are documented to be 23 µg/L (See Section 7.5.5 below). Therefore, the new MCLs for arsenic are less than natural background at the former Pease AFB.

<u>Changes in Exposure Pathways:</u>

There have been no changes in physical conditions, exposure pathways and land use that would affect the protectiveness of the remedy.

<u>Changes in Toxicity and Other Contaminant Characteristics:</u>

Groundwater COCs with risk-based cleanup goals in the *Zone 2 ROD* included 1,2,4-trimethylbenzene, 2-methylnaphthalene, sec-butylbenzene, and isopropylbenzene. As was stated above, updated ARARs based on current toxicity information (NHAGQS) are now available for each of these constituents.

<u>Changes in Risk Assessment Methods:</u>

The human health risk assessment was conducted following EPA and EPA Region 1 guidance. There has not been any significant change in EPA guidance which could result in significant revisions to risk-based cleanup goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs:

LNAPL and residual product are no longer observed in Zone 2 soils. By establishing and maintaining the GMZ the remedy provides protection to human receptors from contaminated groundwater that may present an unacceptable health risk (total cancer risk greater than 10^{-4} to 10^{-6} or a hazard index of greater than 1). Additionally, concentrations of organic constituents in groundwater will continue to decrease via natural attenuation processes. The Air Force, EPA, and NHDES are currently considering approaches to determine if soils at Site 22 still pose a threat to groundwater.

7.5.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.5.4.4 Technical Assessment Summary

The remedy at Zone 2 is functioning as intended. LNAPL and residual product are no longer observed in Zone 2 soils. Both inorganic and organic constituents in groundwater have declined since the implementation of the remedy across Zone 2, and concentrations of organic constituents will continue to decrease via natural attenuation processes. Concentrations of isopropylbenzene, 2-methylnaphthalene, and sec-butylbenzene throughout Zone 2 currently achieve ARARs now available for these constituents. Concentrations of 1,2,4-trimethylbenzene are expected to achieve the current ARAR (330 μg/L) more quickly than the risk-based standard included in the 1995 ROD. The progress of natural attenuation toward achievement of groundwater ROs will continue to be assessed. Potential exposure pathways at the site have not changed. The remedy remains protective because the ICs, including a GMZ, are in place and maintained to prevent groundwater exposures.

7.5.5 Issues

Issues identified for Zone 2 include:

- Decrease in Arsenic Federal and State MCL from 50 μg/L to 10 μg/L.
- Availability of ARARs for groundwater constituents having risk-based standards in the 1995 Zone 2 ROD.

These issues do not impact the future protectiveness of the groundwater remedy across Zone 2. Current arsenic concentrations at the Zone 2 GMZ boundary are less than 23 μg/L, which represents the maximum background value for the former Pease AFB (*Background Values for Soil, Groundwater, Surface Water, and Sediment at Pease Air Force Base.* Weston, 1993c [February]) with the exception of location 22-7771. Arsenic has historically been detected above the background value of 23 μg/L at this location. However, 22-7771 is a boundary point for the Zone 2 GMZ as well as the adjacent Landfill 1 GMZ and lies within the Landfill 1 and Zone 2 Land Use Restriction Zone. Consequently, the area at which 22-7771 is located is completely contained within the boundaries of LUC/ICs implemented and monitored for Zone 2.

7.5.6 Recommendations and Followup Actions

Routine long-term monitoring should continue throughout Zone 2. Annual monitoring should continue along the established GMZ. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess progress toward the Zone 2 RAOs, and to identify opportunities to optimize remedial activities. The ARARs now available for isopropylbenzene, 2-methylnaphthalene, sec-butylbenzene and 1,2,4-trimethylbenzene should be noted in future long-term monitoring reports. The Air Force, EPA, and NHDES should continue discussions relative to the effectiveness of the Site 22 soil remedy, and determine a path forward during calendar year 2004.

7.5.7 Protectiveness Statement

The remedy at Zone 2 remains protective. LNAPL and residual product are no longer observed in Zone 2 soils. Concentrations of organic and inorganic COCs in groundwater have steadily declined across the zone. The remedy is protective of human health and the environment and exposure pathways that could result in unacceptable risks are being controlled by the established GMZ and LUC/ICs.

7.5.8 References

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1999a. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 1999b. *Zone 2 Long-Term Monitoring Plan, Revision 1.* (November)

Bechtel, 2000. *Zone 2 Operating Properly and Successfully Report.* (April)

EPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

Montgomery Watson, 2001. *Zone 2 2000 Annual Report.* (March)

MWH, 2001. *Zone 2 Long Term Monitoring Plan, Revision 2.* (November)

MWH, 2003. *2002 Annual Report and Groundwater Evaluation.* (May)

MWH, 2004. *2003 Annual Report and Groundwater Evaluation.* (June)

Weston, 1995. *Record of Decision, Zone 2 Pease Air Force Base, New Hampshire.*

7.6 ZONE 3, SITES 32/36

7.6.1 BACKGROUND

Zone 3 is located in the central portion of the former AFB and occupies approximately 440 acres (see Figure 7.6-1). The zone contains numerous buildings with adjacent paved parking areas, a network of roads and the flightline area. A large section of Zone 3 covers the flightline area of the base, which includes portions of the runway, aircraft parking apron, and the grassy infield between the aircraft parking apron and the runway. The aircraft parking apron is a major feature of the base, covering nearly one third of the zone. Zone 3 encompasses seven individual IRP sites, including Site 32 (Building 113), Site 33 (Building 229), Site 34 (Building 222), Site 35 (Building 226), Site 36 (Building 119), Site 38 (Building 120), and Site 39 (Building 227). The location of sites 32 and 36 are shown on Figure 7.6-2. Three UST sites (Sites 72, 76, and 81) and one IRP site (Site 73) are located in Zone 3 but have separate reporting requirements and are addressed in other documentation and other sections of this review document. In addition, Site 49 is located outside of the Zone boundary but has recently been included in the *Zone 3 Record of Decision Amendment* (MWH, 2003b). Sites 32 and 36 are discussed in the following sub sections. Other Zone 3 sites are discussed in Section 7.7 of this review document.

7.6.1.1 Site Description

Sites 32 and 36 encompass Buildings 113 (Site 32) and 119 (Site 36) in the center of the base in the area known as the Industrial Shop/Parking Area (see Figure 7.6-2). Much of the site is paved or covered by buildings. Newfields Ditch, a stormwater drainage swale, passes between Buildings 113 and 119. The ditch drains toward the northeast and eventually discharges into Hodgsons Brook. A summary of groundwater contamination existing at each of the sites as well as the remainder of Zone 3 can be found on Figure 7.6-3. Figure 7.6-4 presents a flow diagram for the Site 32 groundwater extraction and treatment system process.

<u>Site 32</u>

Building 113 (Site 32) was used between 1955 and 1991 primarily for aircraft munitions systems and avionics maintenance, including some vapor degreasing operations. A 1,200

gallon (gal), concrete UST was located near the northeastern corner of Building 113. The UST received waste TCE from degreasing operations conducted inside Building 113 from 1956 to 1968. Sometime after 1977, use of the UST was discontinued and it was filled with sand. In 1988, the UST was excavated and removed, and an underground overflow discharge pipe associated with the UST was discovered. The soil and groundwater contamination at this site is believed to be primarily a result of the historic use of the TCE tank and associated overflow pipe.

Site 36

Jet engine and engine accessory maintenance was performed in Building 119 (Site 36) between 1956 and 1990. Prior to 1971, waste generated in the building, including fuel and TCE, was disposed of at a fire training area (Site 8). From 1971 to 1990, these wastes were either drummed or stored in a designated drum storage area on-site for contractor removal or were piped to Building 226 (Site 35, industrial waste treatment plant) for treatment. An underground sewer line located along Dover Avenue, north of Building 119, transported the wastes between buildings. A break in the line between the two buildings may have resulted in a release of contaminants. During the early stages of investigations at Building 119, it was observed that the soil surrounding the drum storage area and oil rack behind the building was visibly stained, apparently from former waste spills.

Zone Wide Geological, Hydrogeological, and Groundwater Flow Descriptions

The shallow subsurface beneath Zone 3 generally consists of five lithologic units. Unconsolidated lithologic units include the US, the MCS, the LS, and a GT. The bedrock underlying these lithologic units is either the Kittery or Eliot formation, depending on the specific Site location within Zone 3. The thickness of the overlying unconsolidated lithologic units varies across the site. In addition, the elevation of the bedrock interface is highly variable which is likely a result of the Zone's glacial history.

Regional groundwater flow is to the south-southeast within Zone 3 under static conditions (i.e., when the Haven well is not being used). There also exists localized flow vectors at each of the Sites depending upon the season. A more detailed description of the geologic, hydrogeologic, and hydrologic characteristics of Zone 3 can be found within *the ROD for Zone 3* (Weston, 1995a).

Groundwater contaminant plumes extending beyond the identified source areas have been delineated at IRP Sites 32 and 36. The identified contaminant plumes are primarily halogenated hydrocarbons (HHCs) with the most extensive groundwater contaminant plume originating from IRP Site 32 (see Figure 7.6-3). The current nature and extent of groundwater contamination at each of the sites within Zone 3 is discussed in the *Zone 3 2003 Annual Report* (MWH, 2004a).

7.6.1.2 Initial Response

As part of the Stage IIIB field investigations in 1990 at Sites 32 and 36, the overflow pipe and contaminated soil near the waste TCE UST were excavated. A total of approximately 315 cubic yards (yd^3) of contaminated soil was removed along with the UST overflow pipe. In addition to the remedial excavation, a pilot groundwater extraction and treatment system was constructed to recover and treat contaminated groundwater from the lower sand.

7.6.1.3 Basis for Taking Action

Remedial Investigation (1983 - 1993): In 1983, an IRP Phase I Problem Identification/Records Search was conducted at Pease AFB. The study identified Sites 32 and 36 as potential sources for the release of TCE into the environment. Subsequently, a remedial investigation was conducted at Sites 32 and 36 in three stages from 1983 through 1993.

The pilot groundwater extraction/treatment system was modified to extract groundwater from shallow fractured bedrock to provide some control of the migration of contaminated groundwater at Site 32 (Weston, 1995b). This pilot plant operated from March 1991 through June 1995.

It was concluded that complete groundwater restoration to ARARs at Site 32, in a reasonable timeframe, was not feasible under any remedial scenario (Weston, 1995b). A Technical

Impracticability (TI) evaluation recommended containment of the Site 32/36 source area to prevent continued migration of contaminated groundwater.

7.6.2 Remedial/Removal Actions

7.6.2.1 Regulatory Actions

The controlling documents that present the selected remedy include:

Record of Decision For Site 32/36 (1995): The Air Force's preferred alternative for remediation as stated in the *ROD For Site 32/36* (Weston, 1995b) involved containment of the source area both physically and hydraulically.

Zone 3 ROD (1995): The Air Force's preferred alternative for remediation as stated in the *Zone 3 ROD* (Weston 1995a) involved the excavation of contaminated soils and sediments, extraction of contaminated groundwater at selected source areas, and natural attenuation of dissolved-phase contaminated plumes including the plume downgradient of the Site 32/36 source area.

Zone 3 ROD Amendment (2003): The *Zone 3 ROD Amendment* (MWH, 2003b) presented a modified Zone 3 cleanup approach to improve the long-term effectiveness of the remedy, and document cleanup actions for sites that were not addressed in the 1995 *Zone 3 ROD*.

7.6.2.2 Remedial Action Objectives

<u>Site 32/36 ROD</u>

The results of the human health and ecological risk assessments revealed that contaminants in the Site 32/36 source area soil did not pose unacceptable risks to human or ecological receptors under current or future exposure pathways selected for the site, except for lead and copper at the former drum storage are at Site 36, which contributed 90% of the total hazard indices that exceeded benchmark values. Due to the limited area that could provide habitat for ecological receptors and other uncertainties associated with the ecological risk assessment, RAOs for ecological risk were not developed. Because some of the contaminants in Site 32/36 source area soil could leach to groundwater at concentrations that could present as unacceptable human health risk, the following source control objective was developed:

- To reduce the migration of contaminants from Site 32/36 source area soil and groundwater such that groundwater outside the TI Zone will attain all chemical-specific groundwater standards within the 30-year reasonable time frame for groundwater restoration (Weston, 1995b).

RAOs addressing contaminants that had migrated to surface water and sediment from the Site 32/36 source area and dissolved phase contaminants in groundwater beyond the boundary of the TI Zone were addressed in the *Zone 3 ROD* (Weston, 1995a).

Original Zone 3 ROD

The remedy selected in the 1995 *Zone 3 ROD* was developed to satisfy the following RAOs applicable to Sites 32/36:

Zone 3 Overburden and Bedrock Groundwater

- Protect human receptors from ingestion of, or direct contact with, contaminated groundwater that may present an unacceptable health risk;
- Comply with chemical-specific ARARs;
- Prevent discharge of contaminated groundwater to surface water bodies where such discharges may cause unacceptable risks to human health and the environment; and
- Prevent contaminant migration toward the Haven well.

Zone 3 ROD Amendment

The first three RAOs for overburden and bedrock groundwater were unchanged. The fourth RAO was revised to allow for increased demand for water from the Haven well.

- Minimize contaminant migration toward the Haven well should increased water demand require pumping the Haven well at the maximum safe yield.

Since Site 32/36 is located outside of the influence of the Haven Well, the amended remedial objective has a minimal impact on Site 32/36.

7.6.2.3 Remedy Description

Site 32/36 ROD

Specifically, the selected remedy for Sites 32 and 36 included the following remedial action components:

- Containment of the source area or dense non-aqueous phase liquid (DNAPL) zone at Site 32 using a vertical barrier (installed in November 1996) and hydraulic control through ground water extraction and treatment (operational February 1997, and Ongoing).
- Excavation and off-site disposal of Site 36 VOC and metals contaminated soil [completed in 1996, (Bechtel, 1998a)].

Subsurface discharge goals were established for groundwater extracted from within the Site 32 TI zone (i.e. the source area) in the *Record of Decision for Sites 32/36* (Weston, 1995b), these goals are presented as Table 7.6-1.

Original Zone 3 ROD

Cleanup goals for the dissolved groundwater plume emanating downgradient of the Site 32 TI zone were developed in the original *Zone 3 Record of Decision* (Weston, 1995a) and are presented as Table 7.6-2. A description of the remedy for portions of Sites 32 and 36 and in areas adjacent to these sites follows below:

- Natural attenuation and biodegradation of the dissolved-phase contaminant plume emanating from the Site 32/36 source area outside the TI containment zone [Ongoing].
- Protect human receptors from exposure to contaminated groundwater by implementing institutional controls, such as establishing a Zone 3 GMZ [Ongoing].
- Long-term environmental performance monitoring in Zone 3, consisting of groundwater sampling (including water level measurement) and analysis for GMZ maintenance, groundwater extraction system performance monitoring, and process monitoring at groundwater treatment facilities (Bechtel, 1999b). [Ongoing].

Zone 3 ROD Amendment

As noted earlier, the *Zone 3 ROD* has been amended (MWH, 2003b); the modified cleanup approach was designed to improve the long-term effectiveness of the remedy, and document cleanup actions for sites that were not addressed in the 1995 *Zone 3 ROD* (Weston, 1995a). Major components of the modified remedy that affected Sites 32 and 36 include:

- Modification of the Zone 3 long-term monitoring program to measure the performance of the selected remedy (MWH, 2004b), which includes monitoring of Haven sentry wells to ascertain if migration of potentially contaminated groundwater will impact the Haven well.
- Cleanup goals for the dissolved groundwater plume downgradient of the Site 32 TI zone were modified by the *Zone 3 Record of Decision Amendment* (MWH, 2003b) from those presented in the original *Zone 3 Record of Decision* (Weston, 2003b) and are presented as Table 7.6-3. These cleanup goals now govern the dissolved plume emanating from both Sites 32 and 36.

7.6.2.4 Remedy Implementation

Soil and Sediment Remedial Action. The selected remedy specified the removal of contaminated soil from Site 36. A total of 1,403 tons of chlorobenzene contaminated soil was removed from Site 36 in 1996 (Bechtel, 1998a).

Groundwater Remedial Action. The selected remedy for Sites 32 and 36 as noted above, required containment of the Site 32 source area through installation of a physical barrier and hydraulic control through extraction and treatment of groundwater. Installation of the sheet piling was completed in November 1996, and pumping of groundwater at Site 32 commenced in February 1997. On-going operation of this containment system and long-term monitoring continue at Site 32. Long-term monitoring of the natural attenuation of site contaminants also continues at Site 36.

The layout of the Site 32 GWTP is shown in Figure 7.6-4. Groundwater is extracted from the Site 32 source area from seven wells located to contain groundwater at the site. These seven wells include three LS wells and four shallow bedrock (SBR) wells. In addition to the seven extraction wells at Site 32, groundwater from three US wells in the historic Site 39 source area and one hybrid well are also treated by the Site 32 GWTP.

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Water pumped from the extraction wells is directed to an equalization tank. The water is then pumped from the equalization tank to three granular activated carbon (GAC) units operating in series (the multimedia filters are currently bypassed due to low suspended solids in the extracted groundwater). Following the GAC units, the flow is directed into an effluent tank prior to discharge from the plant.

Flow from the Site 32 treatment plant is directed to a 300 gal wet well near the Site 34 GWTP. Treated groundwater is pumped from the wet well across the flightline into a 250,000 gal holding tank. From the holding tank the treated water is gravity fed to a groundwater recharge trench (Figure 7.6-4). The recharge trench consists of four 250 ft laterals of perforated poly-vinyl chloride (PVC) pipe installed in the overburden. The ability to discharge to the Pease wastewater treatment facility is available as a contingency. The treated groundwater is often utilized by the adjacent golf course during the spring, summer and fall months.

Historically groundwater extracted from Sites 32, 35, and 39 (from the upper sand only) have been treated by the Site 32 plant. However, as discussed in Section 7.7 groundwater is no longer extracted from Site 35 and groundwater from both the upper sand, lower sand and shallow bedrock units are currently extracted at Site 39 and treated by the Site 32 system.

Current Status of the Groundwater Remedial Action. The downgradient contaminant plume associated with Site 32/36 contains significantly higher concentrations of TCE and its degradation byproducts when compared with the rest of Zone 3. However, Site 32/36 contaminant trends have decreased and the extent of contamination at has also decreased since the implementation of the remedy (MWH, 2004a).

Contaminant concentration levels in the Site 32 source area have consistently decreased since the implementation of the selected remedy (MWH, 2004a). In addition, the concentrations of TCE in shallow bedrock wells 6075 and 6029, situated between the Site 36 and Site 32 source areas, have apparently reached asymptotic levels (MWH, 2004a).

TCE concentrations in the majority of the wells downgradient of Site 32 indicate that TCE concentrations decreased steadily after implementation of the remedy, and concentrations have reached or are near asymptotic levels at several locations (MWH, 2004a). The concentration of TCE has decreased to below the RG in locations downgradient of the source area. Monitoring wells 632 and 6008, approximately 425 feet (ft) downgradient of the source area, have maintained the groundwater restoration goal for three consecutive years (MWH, 2004a). Wells 850 feet downgradient of the Site 32 source area (6031, 6032, and 5032) have maintained the groundwater restoration goal for several years (MWH, 2004a). Since the downgradient dissolved plume emanating from the Site 32 TI area has steadily decreased, the distance from the TI area to the GMZ was also decreased in the spring of 2003 (MWH, 2004a).

Evaluation of water level data indicates that the Site 32 extraction system is maintaining an inward gradient (hydraulic capture) inside the sheet piles (overburden and bedrock). Evaluation of cross-sectional representations of the Site 32 TI area and downgradient dissolved plume comparing contaminant concentrations just after system startup in 1997 and in the year 2003, have yielded the following observations.

- In 1997, the TCE contamination above the Zone 3 RG extended downgradient to well 6033 in the shallow bedrock and also upward into the lower sand at well 573.
- Since system startup, the cross-section of the contaminant plume has decreased in its extent. The levels of TCE and cis-1,2-DCE have decreased to levels that are below restoration goals (wells 632 and 6008) or are just slightly above the cleanup goals (573, Vinyl Chloride [3.3 μg/L, J]).

The cross-sections indicate the containment at Site 32 has been and continues to be effective. The cross-sections also show that natural attenuation has been effective in degrading the downgradient portion of the Site 32 plume.

LUC/ICs are in place for the Zone 3 excepted subparcel, including Site 32/36. The Air Force has retained rights under a 55-year long-term lease on the property which include establishment of LUC/IC measures. These have been implemented, including a GMZ prohibiting use of groundwater, a URZ prohibiting both residential use and establishment of child care facilities, playgrounds or elementary/secondary schools. The Zone 3 GMZ is an ASN requiring concurrence from the Air Force for any development within the GMZ and specifically prohibits any activity that could disturb ongoing remedies. The ongoing use of the property conforms with the restrictions of the URZ, and land use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.6.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999b), concluded that the remedy at Site 32/36 remained protective of human health and the environment. The *Five-Year Review Report* (Bechtel, 1999b) also recommended that annual evaluation of system performance and environmental monitoring continue as a means of identifying opportunities to optimize system performance and long-term monitoring. Evaluation of system performance and optimization efforts were documented in the following:

- *Zone 3 1999 Annual Report.* Bechtel, 2000c. (August)
- *Zone 3 2000 Annual Report.* Bechtel, 2001. (October)
- *Zone 3 2001 Annual Report.* MWH, 2002. (April)
- *Zone 3 2002 Annual Report.* MWH, 2003a. (April)
- *Zone 3 2003 Annual Report.* MWH, 2004a. (April)

Long-term monitoring is described in the *Zone 3 Long-Term Monitoring Plan, Revision 2* (MWH, 2004b).

Source area containment, extracted groundwater treatment, and subsurface discharge have been successful for the Site 32 TI zone. In addition, the dissolved downgradient plume emanating from both Sites 32 and 36 has decreased in magnitude and extent. These successes are documented in the reports noted above.

7.6.4 TECHNICAL ASSESSMENT

The following section discusses the effectiveness of the remedy and describes how the RAOs have been met.

7.6.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

Site 32 hydraulic containment has been effective at containing the source area within the TI zone, and coupled with natural attenuation downgradient, concentrations have significantly decreased since implementation of the groundwater extraction/treatment. Discharge goals have consistently been met by the treatment system.

7.6.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards:

The groundwater treatment goals specified in the *Site 32/36 ROD* were based on a combination of ARARs, TBCs, and risk-based values, with a preference for ARARs. Changes in ARARs for the COCs at Site 32/36 are summarized below.

Constituent	ROD Cleanup Goal (μg/L)/Basis	ARAR Changes/Basis
Chloromethane	3 /NHDPHS	3 /NHAGQS
Dichlorodifluoromethane	1,000 /NHDPHS	1,000 / NHAGQS
1,1-Dichloroethane	81 /NHDPHS	81 /NHAGQS
Isopropylbenzene	89.1 / Risk-based	280 / NHAGQS
Trichlorofluoromethane	2,000 / NHDPHS	2,000 /NHAGQS
1,2,4-Trimethylbenzene	70 /unknown	330 /NHAGQS
Acenaphthene	2,190 /Risk-based	420 /NHAGQS
Benzoic acid	28,000 /NHDPHS	28,000 /NHAGQS
Dimethylphthalate	313,000 /unknown	50,000 /NHAGQS
2,4-Dimethylphenol	730 /Risk-based	140 /NHAGQS
Di-n-butylphthalate	3,650 /Risk-based	34,000 /NHAGQS
2-Methylnaphthalene	13.4 /Risk-based	280 /NHAGQS
4-Methylphenol	350 /NHDPHS	350 /NHAGQS
Naphthalene	20 /NHDPHS	20 /NHAGQS
Arsenic	50 /MCL	10* /MCL

Constituent	ROD Cleanup Goal (µg/L)/Basis	ARAR Changes/Basis
Boron	620 /NHDPHS	620 /NHAGQS
Nickel	100 /NHDPHS	100 /NHAGQS
Potassium	35,000 /NHDPHS	35,000 /NHAGQS

* - A background value of 23 µg/L for arsenic has been established at Pease.

The *Site 32/36 ROD* (Weston, 1995b) indicated a preference for ARARs when establishing cleanup goals. However, many of the listed cleanup goals were actually NHDPHS values, which are TBCs, not promulgated standards. In several cases, these NHDPHS values are the same as NHAGQS, as shown above. The revised MCL for arsenic (10 µg/L) is less than Pease background (23 µg/L).

Changes in Exposure Pathways: Since completion of the last Five Year Review, additional guidance, including EPA's *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (November 2002), have been developed to aid in evaluating the potential for human exposure from this pathway. The Air Force will consider this and any other appropriate guidance to determine if the vapor intrusion pathway at Site 32/36 requires additional analysis.

Changes in Toxicity and Other Contaminant Characteristics: ARARs are now available for COCs that previously had risk-based treatment goals, as shown above. Groundwater contamination remains contained within the GMZ therefore, changes in toxicity and other contaminant characteristics have not impacted the protectiveness of the remedy.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA and EPA Region 1 guidance. There has not been any significant change in EPA guidance which could result in significant revisions to cleanup goals. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs:

The Site 32/36 remedy is achieving the stated RAO of source control. Reductions in groundwater COC concentrations outside the TI zone indicate that natural attenuation is reducing concentrations, indicating progress toward Zone 3 RGs.

7.6.4.3 QUESTION C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that would call into question the protectiveness of the remedy.

7.6.4.4 Technical Assessment Summary

The remedy at Site 32/36 is functioning as intended. Hydraulic control has successfully contained the source area within the TI zone meeting the RAO of source control. Concentrations of COCs have significantly decreased outside the TI zone since implementation of the groundwater extraction/treatment and are progressing towards Zone 3 RGs. Additionally, discharge goals have consistently been met by the treatment system. While minor changes in ARARs have affected groundwater treatment goals, these changes have not impacted the protectiveness of the remedy. The potential vapor intrusion pathway has not been examined and may require analysis if more specific guidance becomes available. The potential exposure pathways at Site 32/36 have not changed and LUC/ICs are in place and performing as expected. The remedy remains protective.

7.6.5 ISSUES

ARARs are now available for numerous COCs assigned treatment goals that were risk-based or based on TBC values in the ROD. The new MCL for arsenic is less than Pease background.

7.6.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine long-term monitoring should continue throughout Zone 3. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess performance of the Site 32 groundwater extraction system and progress toward RGs, and to identify opportunities to optimize remedial activities. System operation and monitoring at the Site 32 GWTP should also be assessed to identify opportunities to optimize extraction to reduce the time to achieving the RGs and increase the cost effectiveness of the operation of the system. The development of ARARs (NHAGQS) for several site COCs should be documented in future long-term monitoring reports. Discharge goals should be updated to match NHAGQS and the Pease background value for arsenic. Additionally, investigation of the possible vapor intrusion pathway should be undertaken when EPA guidance more applicable to commercial buildings is available.

7.6.7 PROTECTIVENESS STATEMENT

The combination of groundwater extraction and treatment, institutional controls, and long-term monitoring ensures that the remedy at Site 32/36 is protective of human health and the environment.

7.6.8 REFERENCES

AFBCA, 2002. Draft Final Land Use Control/Institutional Control Management Plan, Pease Air Force Base. (October)

Bechtel, 1997. *Site 32 System Startup and System Long-Term Monitoring Plan.* (?)

Bechtel, 1998a. *Zone 3 Excavations Remedial Action Report.* (March)

Bechtel, 1998b. *Zone 3 First Year Operations Report.* (September)

Bechtel, 1999a. *Zone 3 1998 Annual Report.* (August)

Bechtel, 1999b. *Five-Year Review Report.* (September)

Bechtel, 2000a. *Zone 3 Groundwater Model Update.* (April)

Bechtel, 2000b. *Zone 3 Optimization Evaluation.* (June)

Bechtel, 2000c. *Zone 3 1999 Annual Report.* (August)

Bechtel, 2001. *Zone 3 2000 Annual Report.* (October)

EPA, 2002. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (November)

MWH, 2002. *Zone 3 2001 Annual Report.* (April)

MWH, 2003a. *Zone 3 2002 Annual Report.* (April

MWH, 2003b. *Zone 3 Record of Decision Amendment.* (December)

MWH, 2004a. *Zone 3 2003 Annual Report.* (April)

MWH, 2004b. *Zone 3 Long-Term Monitoring Plan, Revision 2.* (August)

Weston, 1995a. *Record of Decision for Zone 3.* (September)

Weston, 1995b. *Site 32/36 Record of Decision. (September)*

7.7 ZONE 3, SITES 34/39

7.7.1 Background

Zone 3 is located in the central portion of the former AFB and occupies approximately 440 acres (see Figure 7.6-1). The zone contains numerous buildings with adjacent paved parking areas, a network of roads and the flightline area. A large section of Zone 3 covers the flightline area of the base, which includes portions of the runway, aircraft parking apron, and the grassy infield between the aircraft parking apron and the runway. The aircraft parking apron is a major feature of the base, covering nearly one third of the zone. Zone 3 encompasses eight individual IRP sites, including Site 32 (Building 113), Site 33 (Building 229), Site 34 (Building 222), Site 35 (Building 226), Site 36 (Building 119), Site 38 (Building 120), and Site 39 (Building 227). Sites 32 and 36 were previously documented in Section 7.6 of this *Five-Year Review.* One other IRP site (Site 73, Building 234) is located in Zone 3 but is addressed in Section 7.11 of this document. In addition, Site 49 (Building 22) is located outside of the zone boundary but has recently been included in *Zone 3 Record of Decision ROD Amendment* (MWH, 2003a). Site 49 is addressed in Section 7.12 of this document. Other Zone 3 Sites not included in this section, such as the brooks and ditches that are associated with the zone have been included in Section 8.0 and 9.0 of this *Five-Year Review.*

7.7.1.1 Site Descriptions

Site 32/36

Please see Section 7.6 of this report.

Site 33

Site 33 consists of the Aircraft Maintenance Squadron hangar (Building 229) (see Figure 7.7-1). Operations in the building included cleaning and repairing aircraft fuel systems and tanks. In 1964, an oil/water separator was installed to receive wastes from the building floor drains. Activities of concern at the site include the past use of TCE and a possible fuel/oil spill near the building. The principal area of concern is the former location of the oil/water separator and associated sump in the southwestern corner of the building. These items were removed in October 1991.

In May 1996, 235.27 tons of soil were excavated and removed from west of Building 229. Additional information on the removal is included in the *Zone 3 Excavations Remedial Action Report* (Bechtel, 1998a). Figure 7.6-3 depicts the extent of groundwater exceedances observed at this site in 2003 (MWH, 2004a).

Site 34

The Jet Engine Test Cell (JETC) was used to test the performance of jet engines over complete power ranges (see Figure 7.7-1). Liquid generated from activities at the JETC potentially contained polynuclear aromatic hydrocarbons (PAHs), fuel, hydraulic fluid, and solvents. Before 1989, waste liquid from Building 222 drained directly to the Test Cell Ditch, which forms the uppermost section of Grafton Ditch. In 1989, the test cell bay effluent was discharged to an oil/water separator prior to its discharge to the Test Cell Ditch, while the effluent from the exhaust stack was discharged directly to the Test Cell Ditch. After modification of the test cell in December 1989, only the effluent from the wash-down of the intake stack and the building storm water drains discharged to the Test Cell Ditch. The rest of the effluent was containerized for disposal. Other sources of contamination at Site 34 are the former locations of the 5,000 gallon (gal) UST that was used to store jet fuel, the oil/water separator, and two No. 2 heating fuel USTs. Figure 7.6-3 depicts the extent of groundwater exceedances observed at this site in 2003 (MWH, 2004a).

Site 35

Building 226, referred to as the Industrial Wastewater Treatment Plant, was built in 1956 to house a dissolved air flotation water treatment system (see Figure 7.7-1). The system operated from 1956 to 1975, processing aircraft washwater and wastewater from Buildings 119 and 227. During this period, treated water was discharged to the sanitary sewer system. In 1973, an oil/water separator was installed next to Building 226 to replace the dissolved air flotation system. Beginning in 1974, wastewater that passed through the oil/water separator was discharged into the storm sewer system. In 1989, the oil/water separator discharge was rerouted to the base sanitary sewer system. Building 226 was removed in 1992, and the building foundation was removed in the spring of 1993 and then paved over.

In addition to the oil/water separator, areas of concern at Site 35 include the former 15,000-gal UST and the Hazardous Material Storage Area. The UST was used to store solvents and was located next to the oil/water separator between Buildings 226 and 227. The UST and the oil/water separator were removed in October 1991. The Hazardous Material Storage Area was used for temporary drum storage between 1982 and 1990 and was located on the asphalt area between Building 226 and Dover Avenue. Figure 7.6-3 depicts the extent of groundwater exceedances observed at this site in 2003 (MWH, 2004a).

<u>Site 38</u>

Site 38 consists of several maintenance shops (Building 120) that were used for a variety of purposes when the base was in operation (see Figure 7.7-1). The shops include a sheet metal shop, paint shop, welding shop, battery shop, and a nondestructive testing area. The sources of contamination at Site 38 were the drum storage area and the floor drain pipeline adjacent to the eastern corner of the building.

In April 1997, excavation of contaminated soil was performed on the northwestern and southeastern sides of Building 120 (Bechtel, 1998a). A total of 418.22 tons of soil was removed from the site. Limited long-term monitoring continued during 2003. Figure 7.6-3 depicts the extent of groundwater exceedances observed at this site in 2003 (MWH, 2004a).

<u>Site 39</u>

Site 39 (Building 227 Area) (see Figure 7.7-1) includes the largest hangar at the former Pease AFB, and served as a major maintenance area for aircraft. The hangar was historically used for a variety of general maintenance activities, including degreasing, paint stripping, and minor repairs, and to wash down aircraft. The northern quarter of the hangar housed a wash rack area and a container storage area for hazardous waste. The floor drains in that area were connected to the Building 226 Industrial Wastewater Treatment Plant (Site 35) (1956 to 1974) and later, to the oil/water separator (1974 to 1991). From 1956 to 1974, the floor drains for the other sections of the building (along with the roof drains) connected directly

into the flightline storm water sewer system, which crosses the flightline before discharging into McIntyre Brook. In 1974, a low-flow bypass line was constructed to connect these drains with the Building 226 oil/water separator. Between 1974 and 1991, wastewater from the Building 227 floor drains emptied into the flightline storm sewers only during rainstorms when the wastewater was highly diluted.

The soil and groundwater adjacent to and underneath the building have been the primary areas of concern. Sources of TCE contamination in groundwater are suspected to be solvent, oil, and fuel spills on the floors or outside the building, and wastewater discharged to the flightline storm sewers. Figure 7.6-3 depicts the extent of groundwater exceedances observed at this site in 2003 (MWH, 2004a).

Site 49

Please see Section 7.12 of this report.

Site 65

Site 65 consists of Building 213 which served as a maintenance facility for aircraft ground equipment (see Figure 7.7-1). Releases of hazardous substances to soil and groundwater were associated with a former hazardous materials storage area (HMSA) and a former oil/water separator, and aircraft parking equipment area. The oil/water separator at Building 213 served as part of the aircraft ground equipment maintenance activities and regularly received wastewater along with fuels, lubricants, and solvents through a single floor drain in a wash rack area. The 1,700 gallon separator reclaimed product and returned it to a storage tank inside the building. The remaining wastewater was delivered to the sanitary sewer system. The HMSA, located near the eastern corner of Building 213, was used to store paint and lubricants in a flammables storage shed, and degreasers, and antifreeze were stored atop a temporary metal runway in an unpaved area (Weston, 1994)

Site 73

Please see Section 7.11 of this report.

Zone Wide Geological, Hydrogeological, and Groundwater Flow Descriptions

The shallow subsurface beneath Zone 3 generally consists of five lithologic units. Unconsolidated lithologic units include the US, the MCS, the LS, and a GT. The bedrock underlying these lithologic units is either the Kittery or Eliot formation, depending on the specific Site location within Zone 3. The thickness of the overlying unconsolidated lithologic units varies across the site. In addition, the elevation of the bedrock interface is highly variable which is likely a result of the Zone's glacial history.

Regional groundwater flow is to the south-southeast within Zone 3 under static conditions (i.e., when the Haven well is not being used). There also exists localized flow vectors at each of the Sites depending upon the season. A more detailed description of the geologic, hydrogeologic, and hydrologic characteristics of Zone 3 can be found within the *Zone 3 ROD* (Weston, 1995a).

Groundwater contaminant plumes extending beyond the identified source areas have been delineated at IRP Sites 34, 35, 38, and 39. The identified contaminant plumes are primarily HHCs with the most extensive groundwater contaminant plume originating from IRP Site 39 (see Figure 7.6-3). The current nature and extent of groundwater contamination at each of the sites within Zone 3 is discussed in the *Zone 3 2003 Annual Report* (MWH, 2004a).

7.7.1.2 Initial Response

Site 32/36

Please see Section 7.6 of this report.

Site 34

All the USTs at Site 34 were removed in September 1992. Several other interim remedial measures (IRMs) were performed at Site 34. These measures also included sediment removal from a portion of the Test Cell Ditch and operation of a pilot groundwater extraction and treatment system. The purpose of the extraction system was to provide management of the dissolved phase benzene groundwater plume specifically associated with Site 34.

7.7.1.3 Basis for Taking Action

The Air Force has been conducting an environmental cleanup program at the former AFB since 1983. This program was executed according to the guidelines of the Air Force IRP and the NHDES UST program. The Air Force conducted investigations in Zone 3 in four separate stages between January 1984 and July 1993.

Remedial Investigation (1983 - 1993): In 1983, an IRP Phase I Problem Identification/Records Search was conducted at Pease Air Force Base (report submitted in January 1994). A summary of the investigation reports generated from the various stages of the RI is detailed in the *Zone 3 ROD* (Weston, 1995a). Data collection during the latter part of stage four was used to complete the baseline risk assessment and Zone 3 FS. A more detailed description of each of the sites is presented in the previous subsections and the *Zone 3 Draft Final Remedial Investigation Report* (Weston, 1993a).

Feasibility Study (1993 - 1995): Several remedial investigation and feasibility study reports have been prepared for Zone 3 and sites within or associated with Zone 3, these are summarized below:

- McyIntyre Brook and Lower Newfields Ditch Remedial Investigation/Feasibility Study (Weston, 1993a and Weston, 1993b), for details Section 8.0;
- *Zone 3 Draft Final Feasibility Study Report* (Weston, 1993c), Includes FSs to evaluate source controls for Sites 31, 33, 35, 38, and 39.
- *Installation Restoration Program Stage 3C, Site 34 Feasibility Study*, Pease AFB, NH, (Weston, 1992a).
- *Zone 3 Remedial Investigation Report, Addendum 1, Site 65, Site Investigation,* (Weston 1994).

7.7.2 REMEDIAL/REMOVAL ACTIONS

7.7.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy(s).

Record of Decision For a Source Area Remedial Action At Site 34 (1993): The Air Force's preferred alternative for remediation as stated in the *ROD For a Source Area Remedial Action at Site 34* (Weston 1993c) involved excavation and off-base disposal of contaminated soils.

Explanation of Significant Differences for Remedial Action at Site 34 (1995): The Air Force issued an Explanation of Significant Differences in May of 1995 outlining a change to the method of soil disposal from offsite treatment and disposal to onsite disposal at Landfill 5.

Zone 3 ROD (1995): The Air Force's preferred alternative for remediation as stated in the *Zone 3 ROD* (Weston, 1995a) involved the excavation of contaminated soils and sediments, extraction of contaminated groundwater at selected source areas, and natural attenuation of dissolved-phase contaminated plumes including the plume downgradient of the Site 32/36 TI Zone.

Zone 3 ROD Amendment (2003): The *Zone 3 ROD Amendment* (MWH, 2003a) presented a modified Zone 3 cleanup approach to improve the long-term effectiveness of the remedy, and document cleanup actions for sites that were not addressed in the 1995 *Zone 3 ROD*.

7.7.2.2 Remedial Action Objectives

The Air Force's preferred alternative for remediation as stated in the *Zone 3 ROD* (Weston, 1995a) involved the excavation of contaminated soils and sediments, extraction of contaminated groundwater at selected source areas, and natural attenuation of dissolved-phase contaminated plumes including the plume downgradient of the Site 32/36 TI Zone. RAOs identified in the *Site 34 Remedial Action ROD* (Weston, 1993c), *Zone 3 ROD* (Weston, 1995a), and the *Zone 3 ROD Amendment* (MWH, 2003a), have been summarized below:

Site 34 ROD

The remedy selected in the *Site 34 Remedial Action ROD* (Weston, 1993c) was developed to satisfy the following Remedial Response Objective:

- Minimize leaching of contaminants from the source area soils to groundwater or surface water, thereby reducing the potential for the public to ingest or directly contact contaminated groundwater or surface water that presents a health risk (cumulative cancer risk greater than 10-4 to 10^{-6}, or hazard index greater than 1 for each COC).

Original Zone 3 ROD

The remedy selected in the 1995 Zone 3 ROD was developed to satisfy the following RAOs:

Sediment in Upper Newfields and Upper Grafton Ditches (Sites 19 and 20)

- Protect ecological receptors from direct contact with, or ingestion of, sediment containing contaminants at concentrations that may present a potential unacceptable risk. (See also Section 8.0)

Soil at Sites 33, 38, and 39

- Minimize leaching of contaminants from soil to groundwater or surface water that would result in groundwater or concentrations of surface water contamination that may present an unacceptable health risk.

Zone 3 Overburden and Bedrock Groundwater

- Protect human receptors from ingestion of, or direct contact with, contaminated groundwater that may present an unacceptable health risk;
- Comply with chemical-specific ARARs;
- Prevent discharge of contaminated groundwater to surface water bodies where such discharges may cause unacceptable risks to human health and the environment; and
- Prevent contaminant migration toward the Haven well.

Zone 3 ROD Amendment

The first three RAOs for overburden and bedrock groundwater are unchanged. The fourth RAO was revised to allow for increased demand for water from the Haven well.

- Minimize contaminant migration toward the Haven well should increased water demand require pumping the Haven well at the maximum safe yield.

7.7.2.3 Remedy Description

Site 34 ROD

The remedy selected for the *Source Area Remedial Action at Site 34* (Weston, 1993c) included the following components:

- Excavation of the JETC soils that contained contaminant concentrations exceeding the site-specific cleanup goals. A mobile laboratory was to be set up on site to confirm the removal of contaminated material. The excavated material was to be temporarily stored and dewatered, on-site, prior to removal to the off site facility.

- The excavation was to be backfilled with clean fill to a level that matches existing grade at the site.

- Excavated contaminated materials were to be transported to a treatment facility/disposal location as soon as scheduling allowed. The type of disposal facility was to be chosen (i.e., asphalt batch, RCRA TSD, Subtitle D landfill, on base thermal desorption unit, or other) at the time of remedial design based on cost and other factors.

- Groundwater extracted as part of the excavation and/or dewatering process was to be treated at the existing pilot GWTP. Holding tanks were to be provided for storage of groundwater prior to treatment.

- Prior to completion of remedial activities, EPA, NHDES was to conduct a review as part of the regulatory approval process to ensure that the remedial soil cleanup goals have been met.

- Based on analytical results from sampling performed on the stockpile of excavated soils from the Site 34 soil removal efforts and concurrent changes to the NHDES soil policy guidance, the Air Force issued an ESD in May 1995 to change the location of soil disposal from off-base to on-base. The ESD called for using the Site 34 soils as fill material on Landfill 5 at the former Pease AFB prior to its closure with a RCRA hazardous waste cap.

Original Zone 3 ROD

Specifically, the selected remedy for Zone 3 included the following remedial action components:

- Excavation and removal of sediment exceeding cleanup goals from Upper Newfields and Upper Grafton Ditches [completed 1997, (Bechtel, 1998a)].

- Excavation and removal of soil exceeding cleanup goals at Sites 33, 34, 38, and 39 [completed 1997, (Bechtel, 1998a)].

- Groundwater extraction from Sites 32, 34, 35, and 39 and vicinity, and treatment at the Site 32 Groundwater Treatment Plant (GWTP) [Ongoing] and the Site 34/39 GWTP [shut down in October of 2002].

- Natural attenuation and biodegradation of the dissolved-phase contaminant plume emanating from Zone 3 sites and from the Site 32/36 source area outside the TI containment zone [Ongoing].

- Protect human receptors from exposure to contaminated groundwater by implementing institutional controls, such as establishing a Zone 3 GMZ [Ongoing].

- Long-term environmental performance monitoring in Zone 3, consisting of groundwater sampling (including water level measurement) and analysis for GMZ maintenance, groundwater extraction system performance monitoring, and process monitoring at both groundwater treatment facilities (Bechtel, 1999a). [Ongoing].

<u>Zone 3 ROD Amendment</u>

As noted earlier, the *Zone 3 ROD* has been amended (MWH, 2003a); the modified cleanup approach was designed to improve the long-term effectiveness of the remedy, and document cleanup actions for sites that were not addressed in the 1995 *Zone 3 ROD* (Weston, 1995a). Major components of the modified remedy include:

- Construction of a contingency wellhead treatment system for the Haven well [in progress];

- Optimization of the Site 39 source area groundwater extraction system with monitored natural attenuation of the down-gradient plume [Ongoing];

- Termination of groundwater extraction to control contaminant migration southwest of Sites 34 and 39 [GWTP shut down in October of 2002]; and

- Modification of the Zone 3 long-term monitoring program (ongoing) to measure the performance of the selected remedy, which includes monitoring of Haven sentry wells to ascertain if migration of potentially contaminated groundwater will impact the Haven well.

Ongoing components of the Zone 3 remedies include groundwater extraction at Sites 32 and 39, as well as, optimization, and long-term monitoring of groundwater throughout Zone 3. A summary of the cleanup goals for Zone 3 as listed in both the original *Zone 3 ROD* (Weston, 1995b) and as amended in the recent *Zone 3 ROD Amendment* (MWH, 2003a) are presented as Tables 7.7-1 (soils/sediment), 7.7-2 (groundwater as defined by the original *Zone 3 ROD*), and 7.7-3 (groundwater as defined by the *Zone 3 ROD Amendment*).

7.7.2.4 Remedy Implementation

Soil and Sediment Remedial Actions. Soil and sediment remedial actions required under the original *Zone 3 ROD* were completed in 1996. To achieve the sediment RAOs, the Air Force excavated and disposed off-base 465 tons of sediment from Upper Grafton Ditch and 345 tons of sediment from Upper Newfields that exceeded remediation goals for PAHs and several metals.

The Air Force excavated and disposed off-base 235 tons of soil from Site 33 that exceeded soil remediation goals for arsenic, 418 tons of soil from Site 38 that exceeded remediation goals for polynuclear aromatic hydrocarbons (PAHs). In August 1996, 181.15 tons of contaminated soil were removed from two areas at the southwest corner of Building 227 (Site 39) (Bechtel, 1998a). However, waste characterization sampling of the removed soils did not clearly indicate that a source of the TCE contamination detected in groundwater had been located (Bechtel, 1998a). No compounds were detected at or above applicable cleanup standards. The reported contaminants found in the removed soils consisted primarily of HHCs, BETX compounds, and PAHs.

A soil removal action was also performed under the Site 34 Source Area ROD (Weston, 1993c) in July 1994 to excavate contaminated overburden soils. Approximately 10,700 tons of contaminated soil were excavated from the site. An Explanation of Significant Differences (ESD) for the Site 34 Source Area ROD was completed in May 1995 to change the location of soil disposal from off-base to on-base. The ESD called for using the Site 34 soils as fill material on Landfill 5 at the former Pease AFB prior to its closure with a RCRA hazardous waste cap.

Overview of Groundwater Remedial Actions. To achieve *Zone 3 ROD* groundwater RAOs, initial activities included installation or reconfiguration of eleven wells to extract groundwater for treatment at one of the two groundwater treatment systems constructed under the Site 32/36 and Zone 3 remedies. Three of these wells were to be used for extraction at the Site 39 source area, one well was to be used for extraction at the Site 35 source area, two wells were for extraction at the Site 34 source area, and five wells were for hydraulic control of groundwater flow southwest of Sites 34 and 39. As part of the remedial design process, the pumping strategy was determined based on numerical groundwater flow modeling for optimization of groundwater extraction.

In addition to the construction of the groundwater extraction and treatment systems, the Air Force prohibited the installation of drinking water wells at the former Pease AFB and imposed a 300 gpm pumping limit on the Haven well to prevent groundwater withdrawal from interfering with the contamination migration control system to be implemented as part of the Zone 3 remedy. The pumping limitation was based on groundwater modeling results that indicated that the Zone 3 groundwater extraction systems would prevent plume migration toward the Haven well when it pumped at 300 gpm or less. The 300 gpm limit was further defined by the Air Force as averaged over a 24 hour period. Groundwater extraction and treatment at Sites 32, 34 and 39 has been underway since 1997 to meet Zone 3 groundwater RAOs.

The Zone 3 groundwater model was updated in April 2000 (Bechtel, 2000a), and recommendations were made in the *Zone 3 Optimization Evaluation* (Bechtel, 2000b) to modify the pumping scheme to pump from only 2 wells between Site 34 and the Haven well. The reduction from pumping five wells to pumping two wells was made on August 31, 2000.

The original *Zone 3 ROD* (Weston, 1995a) specified that groundwater would be pumped from Site 39 as part of the selected remedy for Zone 3. The extraction of groundwater at Site 39 began in June 1997 from well 5153 in the flightline. The extracted groundwater was treated at the Site 34/39 GWTP and treated water was discharged at a groundwater recharge trench on the western side of the base runway. The pumping scheme at Site 34/39 was adjusted to extract groundwater from an additional well at Site 39 (well 5152) on August 31, 2000 based on the recommendations in the *Zone 3 Optimization Evaluation* (Bechtel, 2000b).

On October 28, 2002, in accordance with an agreement between the Air Force, NHDES and EPA, extraction and treatment from wells 5152 and 5153 was discontinued on a pilot basis. The decision to discontinue groundwater extraction in the apron area between Site 39 and the Haven Well was formalized in the *Zone 3 ROD Amendment* (MWH, 2003a). The amendment requires groundwater extraction near Site 39 to contain the source area and protect the Haven well if it is pumped at higher rates. It was determined in the amendment that the groundwater RAOs for Site 34 and Site 35 had been met and pumping was no longer required.

Groundwater extraction from wells MWE-4S, MWE-3S, and MW-3S in the suspected source area at Site 39 began in June 1999 and continues at MWE-4S and MW3S to the present. Well MWE3S was abandoned in 2003 and replaced with well MWRE3S located within the US in the historic source area of Site 39. Groundwater extracted from these source area wells is now treated solely by the Site 32 GWTP; operation of the Site 34/39 GWTP was terminated with concurrence from the EPA and NHDES in October 2002.

Under the *Zone 3 ROD Amendment* (MWH, 2003a), the Site 39 groundwater extraction remedy has been optimized to include extraction from a newly installed (August, 2003) hybrid lower sand/shallow bedrock well (MWE10). All extracted groundwater from Site 39 is currently treated at the Site 32/36 GWTP.

Other extracted groundwater treated at the Site 32 plant has historically been from Site 35. A concrete recovery extraction well (CREW) was installed in the southeastern corner of the foundation excavation for potential free product recovery. Pumping from concrete recovery and extraction well began in June 1997, and the extracted groundwater was treated at the Site 32 GWTP and discharged to a groundwater recharge trench on the west-side of the base runway.

The *Zone 3 Semi-Annual Status Report* (Bechtel, 2001a) recommended suspending groundwater extraction from Site 35. Extracted groundwater had met the Zone 3 groundwater restoration goals (RGs) for organics for the previous two years, and the CREW had minimal impact on the groundwater flow near Site 35. This recommendation was applied and extraction from the CREW well at Site 35 was ceased in 2001. In response to recommendations in the *Zone 3 2002 Annual Report* (MWH, 2003b) and correspondence with the EPA groundwater monitoring continued in 2003. Active extraction and treatment at Site 35 remains off line and monitoring continued through 2003.

Current Status of Groundwater Remedial Actions

Site 33

The COC associated with Site 33 has historically been TCE. Monitoring of wells at Site 33 has continued since the implementation of the selected remedy. Results of the groundwater monitoring in 2003 indicate no exceedances of the Zone 3 RGs (MWH, 2004a) since the removal of site soils late in 1997 (Bechtel, 1998b). The Zone 3 RGs have been achieved at Site 33. As agreed to with USEPA and NHDES, long-term monitoring at Site 33 has been reduced under the *Zone 3 Long-Term Monitoring Plan, Revision 2* (MWH, 2004b).

Site 34

Extraction from these wells was terminated during October 2002 under the approval of EPA and NHDES. The *Zone 3 ROD Amendment* (MWH, 2003a) concluded that the groundwater RAOs have been met and formalized the termination of groundwater extraction at Site 34.

Site 35

It was recommended in the *Zone 3 2002 Annual Monitoring Report* (MWH, 2003b) that annual sampling of the wells at Site 35 continue in 2003 in accordance with the *Zone 3 Revised LTMP* (Bechtel, 1999a) for one more year. The *Zone 3 ROD Amendment* (MWH, 2003a) concluded that the groundwater RAOs have been met and formalized the termination of groundwater extraction at Site 35. Therefore, only minimal groundwater monitoring at Site 35 is required under the *Zone 3 Long-Term Monitoring Plan, Revision 2* (MWH, 2004b).

Site 38

As with most of Zone 3, the contamination associated with Site 38 is TCE and its degradation byproducts. There were no exceedances of the Zone 3 RGs in 2003. It was recommended in the *Zone 3 2002 Annual Monitoring Report* (MWH, 2003b) that monitoring of this site continue in accordance with the *Revised Zone 3 LTMP* (Bechtel, 1999a) for one more year. The Zone 3 RGs have been achieved at Site 38, and USEPA and NHDES have concurred that reduced monitoring is required at Site 38 under the *Zone 3 Long-Term Monitoring Plan, Revision 2* (MWH, 2004b).

Site 39

A decision on the configuration of the optimized Site 39 system was agreed upon by the AFRPA, the USEPA, and the NHDES, after regulatory review of the *Technical Memorandum: Site 39 Groundwater Investigation Phase III* (MWH, 2003c). The system consists of the newly installed well MWE10 as a hybrid deep overburden/shallow bedrock extraction well coupled with the two existing shallow over burden extraction wells (MW3S and MWE4S) as well as the newly installed replacement well MWRE3S.

Exceedances of the RGs observed in 2003 for the primary COC TCE, that can be directly attributed to Site 39, occurred at MWE2S, MWE4S, MW3S, MWRE3S, MWE6, MWE1D, MWE9, and 6055 (at 80 feet below top of casing). Exceedances of the RG for cis-DCE occurred at MWE4S, MW3S, MWRE3S, MWE1D, MWE7, MWE8, and MWE9. Exceedances of the RG for VC occurred at MWE2D, MWE4S, MWRE3S, and MW3S. Exceedances of the RG for 1,1-DCE occurred at MW3S and MWE4S and for trans-DCE at MW3S (MWH, 2004a).

The observed exceedances in the source area are an order of magnitude higher than those observed cross gradient and down gradient of the source area. Analytical sampling of Site 39 is conducted in accordance with the *Zone 3 Long-Term Monitoring Plan, Revision 2* (MWH, 2004b).

Haven Well Protection

A sentry well network is included in the *Zone 3 Long-Term Monitoring Plan, Revision 2* (MWH, 2004b) to provide protection of the Haven well required by *Zone 3 ROD Amendment* (MWH, 2003a). The objective of the sentry well network is to monitor contaminant migration potentially threatening the Haven well. The sentry wells are located approximately 110 feet to 520 feet from the Haven well. Three wells will be installed during Fall 2004 to enhance monitoring coverage in the Lower Sand (LS) and Shallow Bedrock (SB) units in the area of the Haven well. The proposed sentry well sampling frequency is enhanced to increase protection of the Haven well water supply. In addition to this monitoring well network, a contingency wellhead treatment system has been designed and is currently under construction. Construction will be completed during Fall 2004.

The contingency wellhead treatment system has been designed to be capable of treating extracted water from the Haven well potentially contaminated with volatile organic compounds (VOCs). The constructed system shall include the addition, removal, and reutilization of various system components, as well as existing space within the existing Grafton Street Groundwater Treatment System. System upgrades consist of some minor interior modifications, an addition to the exterior of the existing building, including a prefabricated-engineered building, in order to house the proposed process equipment.

Groundwater extracted from the Haven well aquifer will be pumped via the existing infrastructure (e.g., the Haven well pump, pump house, piping, etc.). The treatment system design maximum flow rate is based upon the Haven well pump capacity. The maximum design flow rate of 1,000 gallons per minute (gpm) was utilized to size the equipment. The process equipment is designed to remove VOCs from water entering the treatment plant at an influent concentration of 10 μg/L of TCE and 50 μg/L of benzene and an effluent concentration of 2.5 μg/L for both COCs. Vapor treatment has been sized based upon the requirements of the airflow rate of the air stripping equipment (1,250 standard cubic feet per minute [scfm]), as well as effluent gas concentrations.

LUC/ICs are in place for Zone 3 in the form of restrictions in the long-term lease that was executed between the Air Force and the PDA. The lease includes several LUC/IC measures, as described in the *Zone 3 ROD Amendment* (MWH, 2003a). These include a GMZ prohibiting use of groundwater (except for the Haven well) and a URZ prohibiting both residential use and establishment of child care facilities, playgrounds or elementary/secondary schools. Any activity that will adversely impact the integrity of the monitoring wells, treatment facilities, piping, and other facilities is prohibited. The Zone 3 GMZ is an ASN requiring concurrence from the Air Force for any development within the GMZ and specifically prohibits any activity that could disturb ongoing remedies. With the exception of ongoing remedial systems, groundwater extraction inside the Zone 3 GMZ is limited to the Haven well. The ongoing use of the property conforms with the restrictions of the URZ, and this is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.7.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999b), concluded that the remedy at Zone 3 remained protective of human health and the environment. Recommendations in the *Five-Year Review Report* included:

- Annual evaluation of environmental monitoring data to optimize system operation and refine long-term monitoring activities;
- Monitoring and evaluation of natural attenuation processes to determine effectiveness;
- Annual evaluation of progress toward cleanup and assessment of opportunities to refine monitoring activities.

Long-term monitoring has been performed since 1999 to meet the recommendations presented above. Evaluation of these monitoring results, and minor adjustments to the long-term monitoring program, were presented in the following documents:

- *Zone 3 1999 Annual Report*. Bechtel, 2000c. (August)
- *Zone 3 2000 Annual Report*. Bechtel, 2001b. (October)
- *Zone 3 2001 Annual Report*. MWH, 2002b. (April)

- *Zone 3 2002 Annual Report*. MWH, 2003b. (April)
- *Zone 3 2003 Annual Report*. MWH, 2004a. (April)
- *Revised Zone 3 Long-Term Monitoring Plan*. Bechtel, 1999a. (September)
- *Zone 3 Long-Term Monitoring Plan, Revision 2*. MWH, 2004b. (August)

Additional investigation activities were performed to optimize the remedial system at Site 39. These investigation activities were documented in the following:

- *Site 39 Groundwater Investigation 2001 Technical Memorandum* (Montgomery Watson, 2001a);
- *Site 39 Groundwater Investigation Data Report* (Montgomery Watson, 2001b);
- *Summary of Results of the April 2002 Haven Well Safe Yield Test* (MWH, 2002a);
- *Site 39 Phase II Groundwater Investigation Work Plan* (MWH, 2002c);
- *Site 39 Phase III Groundwater Investigation Work Plan* (MWH, 2003d);
- *Technical Memorandum: Site 39 Phase II Groundwater Investigation Report* (MWH, 2003e); and
- *Technical Memorandum: Site 39 Groundwater Investigation Phase III* (MWH, 2003c).

The *Zone 3 ROD Amendment* (MWH, 2003a) was finalized with the purpose of improving the long-term effectiveness of the remedy, and documenting cleanup actions for sites that were not addressed in the 1995 *Zone 3 ROD*.

A revised long-term monitoring plan for Zone 3 has been approved the EPA and NHDES (*Zone 3 Long-Term Monitoring Plan, Revision 2* [MWH, 2004b]). This long-term monitoring plan outlines changes in monitoring to address the anticipated future increased use of the Haven Well, progress toward groundwater restoration goals throughout Zone 3, and the optimized Site 39 groundwater extraction system. Construction activities have been completed on the optimized Site 39 extraction system and startup of the optimized system commenced in the spring of 2004.

As documented in the *Zone 3 2003 Annual Report* (MWH, 2004a) Sites 33, 35, and 38 have met the Zone 3 groundwater restoration goals established in both the original and amended *Zone 3 RODs* (Weston, 1995b and MWH, 2003f). The *Zone 3 LTMP, Revision 2* calls for reduced monitoring at Site 33, 35 and 38 and eliminates monitoring at Site 34. .

7.7.4 TECHNICAL ASSESSMENT

The following section discusses the effectiveness of the remedy and describes how the RAOs have been met.

7.7.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the decision documents, as described below:

Site 33 soils were excavated and disposed of offsite and reduced long-term monitoring for groundwater is required at the site. Site 34 soils were excavated and disposed of; the site has met groundwater restoration goals and groundwater monitoring associated with Site 34 was eliminated in the *Zone 3 LTMP, Revision 2* (MWH, 2004b). Site 35 has met the groundwater restoration goals and USEPA and NHDES have concurred that reduced monitoring is required under the *Zone 3 LTMP, Revision 2* (MWH, 2004b). Site 38 soils were excavated and disposed of; groundwater restoration goals have been met, and USEPA and NHDES have concurred that reduced groundwater monitoring is required. The newly optimized extraction and treatment system at Site 39 will meet the source area hydraulic control objective of the *Zone 3 ROD Amendment*. The GMZ was not violated between 1999 and 2003, and the size of the GMZ was decreased, based on current contaminant distribution. There were no exceedances of any Zone 3 RGs at the Haven well between 1999 and 2003. The contingency Haven wellhead treatment system will be constructed as required under the *Zone 3 ROD Amendment* (MWH, 2003a).

All extracted groundwater in Zone 3 is now treated at the Site 32 treatment plant. Cleanup goals for Site 32 are discussed in Section 7.6 of this *Five-Year Review Report*.

Excavated soils at Site 34 and Site 39 were removed to cleanup levels established in the *Site 34 and Zone 3 RODs* (Weston, 1995a). Surface water and sediment cleanup goals associated with Zone 3 are addressed in Sections 8.5 and 9.5 of this document.

7.7.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards : Zone 3 groundwater cleanup goals, as specified in the *Zone 3 ROD* (Weston, 1995a) were generally based on ARARs or TBCs, e.g., MCLs or NHDPHS values (Table 7.7-2). The cleanup goals for Zone 3 groundwater were updated, and termed restoration goals (RGs) in the *Zone 3 ROD Amendment* (MWH, 2003a). Some COCs from the original Zone 3 ROD were omitted from the *Zone 3 ROD Amendment* RGs, because cleanup levels had been attained throughout Zone 3. The ARARs used to define the Zone 3 RGs stated in the *Zone 3 ROD Amendment* remain current with one exception. An ARAR is now available for sec-butylbenzene (NHAGQS = 260 μg/L). Sec-butylbenzene had a risk-based RG in the *Zone 3 ROD Amendment* of 7.3 μg/L.

Changes in Exposure Pathways: The future increased usage of the Haven well will draw more water from Zone 3 and the Haven aquifer. The sentry well monitoring system and contingent Haven well treatment system will ensure that the remedy remains protective.

Changes in Toxicity and Other Contaminant Characteristics: Risk-based groundwater restoration goals were included in the *Zone 3 ROD Amendment* for sec-butylbenzene and vanadium. As was stated above, an ARAR is now available for sec-butylbenzene, based on recent toxicity data.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA and EPA Region 1 guidance. There has not been any significant change in EPA guidance which could result in significant revisions to the cleanup goals. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment is consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: Implementation of the remedy is currently meeting all RAOs except compliance with ARARs in groundwater. Progress toward this RAO is documented throughout Zone 3, and it is expected that RGs will eventually be achieved throughout Zone 3, with the exception of the TI Zone at Site 32.

7.7.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that would call into question the protectiveness of the remedy.

7.7.4.4 Technical Assessment Summary

The remedy for Zone 3 is functioning as intended. Soil removal actions were performed at Sites 33, 34, 38, and 39, and groundwater RGs have been met at Sites 33, 34, 35, and 38. There has been no violation of the GMZ between 1999 and 2003, and there have been no exceedances of any Zone 3 RGs at the Haven well between 1999 and 2003. Additionally, the Site 39 extraction and treatment system at Site 39 will meet the source area hydraulic control objective of the *Zone 3 ROD Amendment*, and the contingency Haven wellhead treatment system is being constructed as required under the *Zone 3 ROD Amendment*. While minor changes in ARARs have affected groundwater cleanup levels, these changes have not impacted the protectiveness of the remedy. Increased use of the Haven well is planned in the future; however, the sentry well monitoring network and contingency treatment system will ensure that the remedy remains protective. No other information has come to light that would call into question the protectiveness of the remedy.

7.7.5 ISSUES

An ARAR is now available for sec-butylbenzene (NHAGQS = 260 μg/L). Sec-butylbenzene had a risk-based RG in the *Zone 3 ROD Amendment* of 7.3 μg/L.

7.7.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine long-term monitoring should continue throughout Zone 3. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess performance of the Site 39 groundwater extraction system, to assess the potential need to operate the Haven wellhead treatment system, to evaluate progress toward RGs, and to identify opportunities to optimize remedial activities. The change in the NHAGQS for sec-butylbenzene should be noted in future long-term monitoring reports.

7.7.7 PROTECTIVENESS STATEMENT

Active remedial measures (groundwater extraction and treatment; contingency wellhead treatment), long-term monitoring of remedial performance, and enforcement of ICs ensure that the remedy in Zone 3 is protective of human health and the environment.

7.7.8 REFERENCES

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan, Pease Air Force Base.* (October)

Bechtel, 1998a. *Zone 3 Excavations Remedial Action Report.* (March)

Bechtel, 1998b. *Zone 3 First Year operations Report.* (September)

Bechtel, 1999a. *Revised Long-Term Monitoring Plan.* (September)

Bechtel, 1999b. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000a. *Zone 3 Groundwater Model Update.* (April).

Bechtel, 2000b. *Zone 3 Optimization Evaluation.* (June)

Bechtel, 2000c. *Zone 3 1999 Annual Report.* (August)

Bechtel, 2001a. *Zone 3 Semi-Annual Status Report.* (January)

Bechtel, 2001b. *Zone 3 2000 Annual Report.* (October)

EPA, 1999. Letter from M. J. Daly (Remedial Project Manager) to A. Ditto (AFCEE), *Zone 3: Site 65 Closure.* (November)

Montgomery Watson, 2001a. *Site 39 Groundwater Investigation 2001 Technical Memorandum.* (August)

Montgomery Watson, 2001b. *Site 39 Groundwater Investigation Data Report.* (November)

MWH, 2002a. *Summary of Results of the April 2002 Haven Well Safe Yield Test.* (August)

MWH, 2002b. *Zone 3 2001 Annual Report.* (April)

MWH, 2002c. *Site 39 Phase II Groundwater Investigation Work Plan.* (August)

MWH, 2003a. *Groundwater Flow and Fate and Transport Modeling in the Area of Plume 13/14 and the Haven Well.* Technical Memorandum. (March)

MWH, 2003a. *Zone 3 Record of Decision Amendment.* (December)

MWH, 2003b. *Zone 3 2002 Annual Report.* (April)

MWH, 2003c. *Technical Memorandum: Site 39 Groundwater Investigation Phase III.* (November)

MWH, 2003d. *Site 39 Phase III Groundwater Investigation Work Plan.* (July)

MWH, 2003e. *Technical Memorandum: Site 39 Phase II Groundwater Investigation Report.* (June)

MWH, 2004a. *Zone 3 2003 Annual Report.* (April).

MWH, 2004b. *Zone 3 Long-Term Monitoring Plan, Revision 2* (August).

Weston, 1992a. *Site 32/36 Remedial Investigation.* (June)

Weston, 1992b. *Site 34 Feasibility Study.* (June)

Weston, 1993a. *Zone 3 Remedial Investigation Report.* (September)

Weston, 1993b. *Zone 3 Feasibility Study Report.* (November)

Weston, 1993c. *Record of Decision For a Source Area Remedial Action At Site 34.* (September)

Weston, 1994. *Zone 3 Remedial Investigation Report Addendum 1 Site 65 Site Investigation.* (November)

Weston, 1995a. *Record of Decision for Zone 3.* (September)

Weston, 1995b. *Technical Memorandum – Site 34/39 Performance Test.* (October)

Weston, 1995c. *Site 32/36 Record of Decision.* (September)

Weston 1995d. Technical Memorandum - Site 35 Crew Performance Test. (October)

7.8 ZONE 4, LANDFILL 6

7.8.1 BACKGROUND

7.8.1.1 Site Description

LF-6 is a former landfill that covered approximately 3 acres on the southeastern margin of Pease AFB (Figure 7.8-1). The site of the former landfill; is bordered by Grafton Ditch and associated wetlands to the north, woodlands and Construction Rubble Dump 2 (CRD-2) to the east, and wetlands and woodlands to the west and south (Figure 7.8-2).

Groundwater flow in the overburden at LF-6 is generally toward the east. However, historical monitoring has shown that seasonal variation of groundwater elevations influences groundwater flow in both a northeasterly (spring) and southeasterly (summer) direction. Groundwater flow in the bedrock at LF-6 appears to be oriented to the east during times of high groundwater potential (spring) and to the east-southeast during times of low groundwater potential (fall). Generally, topography and the nearby surface water features (Grafton Ditch and associated wetlands) influence groundwater flow patterns in this area.

LF-6 reportedly received domestic and industrial solid wastes in the early 1970s. Some of this waste may have included spent thinners and solvents as well as medical waste from the former base clinic. The refuse was buried in the landfill using trench and fill methods (Weston 1993a).

7.8.1.2 Initial Response

No remedial action was performed at Landfill 6 prior to the finalization of the *Zone 4 Record of Decision* (Weston, 1995).

7.8.1.3 Basis for Taking Action

Remedial Investigation and Feasibility Study (1993): IRP investigations associated with Zone 4 began in 1983 with a Phase I investigation and culminated in 1993 with the completion of the remedial investigation and feasibility study (Weston 1993a, Weston 1993b). The remedial investigation found that contamination was widespread within the landfill. In general, it was found that the eastern portion of the landfill contained more industrial solid waste and that the western portion contained more organic contaminants with some medical waste.

7.8.2 REMEDIAL/REMOVAL ACTIONS

The following subsections describe regulatory actions and remedial actions performed at Landfill 6.

7.8.2.1 Regulatory Actions

Record of Decision (1995):

The *Zone 4 Record of Decision* (Weston, 1995) documented the selection of Alternative 4, which included landfill excavation with on-base disposal at LF-5, on-zone groundwater treatment for excavation dewatering, discharge of treated water to the local Public Owned Treatment Works, wetland creation, natural attenuation of residual contaminated groundwater, long-term environmental monitoring, and institutional controls.

7.8.2.2 Remedial Action Objectives

The *Zone 4 ROD* (Weston, 1995) identified the following RAOs for Landfill 6:

- Protection of ecological receptors from direct contact with landfill soils/wastes at concentrations that could pose an unacceptable risk;
- Remediation of contaminated landfill soil and solid waste to prevent leaching to surface water and groundwater that could pose an unacceptable risk;
- Compliance with ARARs and background levels, as appropriate, for soil and groundwater; and
- Protection of human receptors from ingestion of contaminated groundwater that could pose an unacceptable risk.

7.8.2.3 Remedy Description

The remedy selected in the *Zone 4 ROD* included the following:

- Excavation and removal of all landfill soil and solid waste from LF-6 and disposal of excavated soil and solid waste in LF-5 prior to final closure of LF-5 with a RCRA cap. All landfill soil and solid waste would be screened during excavation to separate out drums, stained soils, or pockets of visually differing materials. A hazardous waste determination, in accordance with 40 CFR Part 261-Identification and Listing of Hazardous Waste, would be made on suspect materials. Materials classified as hazardous would be disposed of off base at an appropriate treatment/disposal facility.

- Dewatering of the LF-6 excavation area, as necessary, during the excavation process (i.e., the groundwater table to be artificially lowered in the immediate vicinity of excavation rendering the area to be excavated dry. Any groundwater extracted as part of the dewatering process would be treated in an on-zone mobile treatment unit to meet site-specific groundwater treatment objectives. Treated groundwater would be discharged to the local POTW via the sanitary sewer.

- Creation, re-establishment, and enhancement of wetland within the footprint of LF-6 on completion of excavation activities.

- Natural attenuation and biodegradation of residual contaminated groundwater. Contaminant transport modeling performed for LF-6 groundwater estimated that the groundwater cleanup goal for benzene (5 μg/l) would be achieved in approximately 10 years through natural attenuation. Benzene was considered an accurate predictor of the attenuation rates for LF-6 groundwater contaminants.

- Management of the Zone 4 groundwater release would be implemented through a groundwater management permit in accordance with the New Hampshire regulations contained in Env-Ws 410 (now Env-Wm 1403).

- Placement of deed restrictions on the use of groundwater at LF-6.

- Long-term environmental monitoring in the zone, including groundwater, surface water, and sediment sampling and analysis.

Groundwater clean-up goals established for LF-6 are summarized in Table 7.8-1. Surface water and sediment monitoring requirements associated with LF-6 (Lower Grafton Ditch) are described in Section 9.5 of this *Five-Year Review Report*.

7.8.1.4 Remedy Implementation

Remedial activities associated with the IRP for LF-6 were initiated in March of 1995 and completed in August of 1996. The remedial action included excavation and the removal of all landfill soil and solid waste from LF-6 and disposal of the non-hazardous portion of the excavated material in LF-5 before the landfill was closed. The hazardous portion of the excavated material was disposed off base at an appropriate treatment/disposal facility.

Wetlands were created within the footprint of LF-6 to offset wetland impacts that occurred with the construction of the cap at LF-5. Natural attenuation was selected as the mechanism to remediate the contaminated groundwater.

Remediation work at LF-6 commenced in early spring of 1995 with the construction of an access road, a berm around the existing wetland at LF-6, and the excavation of the contaminated materials. The wetland's restoration work commenced per plans approved by the EPA and the New Hampshire Wetlands Bureau in August 1995. These plans were a modification of the technical memorandum developed by CH2M Hill (CH2M Hill, 1994). All completed zones of the wetland mitigation area were seeded in September 1995, with the exception of the area around the berm, which was partially removed and graded during the late summer in 1996. Planting of woody materials and emergents was completed during the summer of 1996. Replanting occurred in 1998.

Environmental monitoring has been performed at LF-6, as required under the *ROD for Zone 4* (Weston, 1995). Groundwater monitoring is described in the following paragraphs; surface water/sediment monitoring requirements are included in Section 9.5 of this *Five-Year Review Report.*

In 2000, a *Demonstration of Remedial Actions Operating Properly and Successfully* (AFBCA, 2000) was submitted for LF-6, documenting decreasing trends in groundwater contaminants. In accordance with the *Landfill 6 Long Term Monitoring Plan Revision 2* (MWH, 2003), groundwater samples are currently collected on an annual basis during the spring sampling event from 5 GMZ perimeter monitoring wells and analyzed for VOCs. Samples from 5 interior GMZ wells are collected on a triennial (every third year) basis in the spring to characterize contaminant levels inside the GMZ and track the progress of natural attenuation processes. VOCs and total metals are the required analyses (MWH, 2003).

Since removal of the contaminant source was completed in 1995, the frequency of exceedances at overburden and bedrock wells for both the organic and inorganic criteria has decreased. The data show that the removal of the contaminated soil and landfill debris have eliminated any further releases of contamination into the groundwater, resulting in a significant beneficial effect on groundwater quality beneath the landfill and elsewhere in Zone 4. The data also provide supporting evidence that natural attenuation processes are actively reducing groundwater contamination that previously migrated from LF-6.

Based on 2003 data, benzene and 2-butanone were the only organic constituents reported above cleanup goals. Benzene was reported in one well (6-5552) at 8 μg/L (cleanup goal = 5 μg/L). 2-butanone was reported in one well (6-533) at 430 μg/L (cleanup goal = 170 μg/L). No organic constituents were reported in GMZ wells at concentrations above cleanup standards (MWH, 2004).

During 2003, arsenic concentrations in three wells exceeded the ROD cleanup goal of 50 μg/L. Detected concentrations in these wells ranged from 68.1 μg/L (well 6-5552) to 780 μg/L (well 6-5553). Arsenic concentrations have consistently exceeded the cleanup goal specified in the ROD at these wells in the footprint of LF-6. However, no GMZ wells contained arsenic or other inorganic COC at concentrations above the cleanup goals.

LUC/ICs are in place for Landfill 6 in the form of restrictions in the deed which was executed between the Air Force and the current owner of the property (PDA). The deed implemented a GMZ prohibiting use of groundwater. The Landfill 6 GMZ has been established as an ASN requiring concurrence from the Air Force for any development within the GMZ and specifically prohibits any activity that could disturb ongoing remedies or monitoring. The ongoing use of the property conforms with the restrictions of the GMZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.8.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedy for Landfill 6 remained protective of human health and the environment. The following recommendations were included in the *Five-Year Review* (Bechtel, 1999):

- Annual evaluation of environmental monitoring data to identify progress toward cleanup goals; and
- Evaluation of monitoring data to identify opportunities to refine long-term monitoring.

The *Five-Year Review Report* (Bechtel, 1999) indicated that it was "not unreasonable" to expect RAOs to be met before the next Five-Year Review.

Annual evaluation of system performance, progress toward cleanup goals, and optimization efforts were documented in the following:

- *Landfill 6 Wetlands Third Annual Mitigation Monitoring Report Addendum.* Bechtel, 2000 (January).
- *Landfill 6 1999 Annual Report.* Bechtel, 2000 (June).
- *Landfill 6 Operating Properly and Successfully Report.* AFBCA, 2000 (May).
- *Landfill 6 2000 Annual Report.* Bechtel, 2001 (April).
- *Landfill 6 2001 Annual Report.* MWH, 2001b (December).
- *Landfill 6 2002 Annual Report.* MWH, 2002 (November).
- *Landfill and Construction Rubble Dump 2003 Annual Report.* MWH, 2004 (March).

Optimization of the LF-6 long-term monitoring program was documented in the following:

- Landfill 6 Long-Term Monitoring Plan, Revision 1. Bechtel, 2000 (November).
- Landfill 6 Long-Term Monitoring Plan, Revision 2. MWH, 2003 (July).

7.8.4 TECHNICAL ASSESSMENT

7.8.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The Landfill 6 remedy is functioning as intended. No source material remains in the landfill. Semi-annual inspections are performed and maintenance is performed as needed. LUC/IC are maintained, including a GMZ, to prevent potential exposures. Long-term monitoring results indicate that concentrations of only two organic COC in groundwater remain above cleanup goals in the former source area (2-butanone and benzene). No organic constituents are present above cleanup goals at the GMZ. Arsenic is the only inorganic COC that is still present above *Zone 4 ROD* (Weston, 1994) cleanup goals and Pease background concentrations, but does not exceed either benchmark at the GMZ. However, arsenic concentrations have remained stable over time, and do not exhibit a decreasing trend, indicating that cleanup goals are not likely to be met in the near term.

7.8.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

<u>Changes in Standards :</u> With the exception of one constituent, (1,2,4-trimethylbenzene) groundwater cleanup standards at LF-6 were based on Safe Drinking Water Act MCLs, New Hampshire Drinking Water Quality Standards (MCLs) (Env-Ws 316, 317, and 318), and NHAGQS (Env-Wm 1403). These standards remain current, with the exceptions noted below:

<u>Arsenic:</u> On January 22, 2001, EPA adopted a new Federal MCL for arsenic (changed from 50 μg/L to 10 μg/L). Similarly, the New Hampshire MCL was reduced from 50 μg/L to 10 μg/L on February 8, 2002. Background concentrations of arsenic at the former Pease AFB are documented to be 23 μg/L (See Section 7.8.5 below). Therefore, the new MCLs for arsenic are less than natural background at the former Pease AFB.

1,2,4-Trimethylbenzene. A NHAGQS was not established for 1,2,4-trimethylbenzene at the time of the *Zone 4 ROD*, and the ROD included a risk-based standard for this compound. However, as of April 15, 2004, New Hampshire established a NHAGQS of 330 µg/L for this compound (NHDES Site Remediation Program, 2004).

These changes in ARARs do not affect the protectiveness of the remedy. While arsenic is reported in site monitoring wells at concentrations above the new MCL, it is not present in GMZ wells at concentrations above Pease background. The NHAGQS established for 1,2,4-trimethylbenzene is more than an order of magnitude higher than the risk-based standard established in the *ROD for Zone 4* (Weston, 1995). 1,2-4-Trimethlybenzene has not been reported in groundwater at the site at concentrations above the risk-based standard since 1993.

Changes in Exposure Pathways: There have been no changes in potential exposure pathways.

Changes in Toxicity and Other Contaminant Characteristics: 1,2,4-Trimethylbenzene was the only groundwater COC with a risk-based cleanup goal in the *ROD for Zone 4*. The recently established NHAGQS is based on up to date toxicity information.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA, and EPA Region 1 guidance. There has not been any significant change in EPA guidance which could result in significant revisions to the cleanup goals. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: Only the concentrations of total arsenic in groundwater in the former source area of LF-6 have not exhibited a downward trend toward achievement of cleanup goals. Additionally 2-butanone continues to be detected sporadically at one location above the cleanup goal. This lack of a downward trend for arsenic and the sporadic detections of 2-butanone suggest that cleanup goals for arsenic and 2-butanone will not be achieved in the near term.

7.8.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.8.4.4 Technical Assessment Summary

As is described in Section 7.8.4.1 through 7.8.4.3 above, the remedy is generally functioning as intended at Landfill 6 to protect human health and the environment. While minor changes in ARARs have affected groundwater cleanup levels, these changes have not impacted the current protectiveness of the remedy, based on site-specific groundwater monitoring data. No changes in exposure pathways are affecting the protectiveness of the remedy. The remedy is currently progressing toward achievement of RAOs, with the exception of the lack of a significant downward trend in arsenic concentrations, and sporadic detections of 2-butanone, in groundwater. LUC/ICs are in place and performing as expected. The remedy remains protective.

7.8.5 ISSUES

Issues identified for LF-6 include:

- Decrease in Arsenic Federal and State MCL from 50 µg/L to 10 µg/L.
- Lack of downward trend in groundwater arsenic concentrations and sporadic detections of 2-butanone in the footprint of the former landfill.

The new MCL for arsenic does not affect the short-term protectiveness of the groundwater remedy at Landfill 6. Current arsenic concentrations at the GMZ are less than 23 µg/L, which represents the maximum background value for the former Pease AFB (Weston, 1993c). The second issue does affect the timeframe for achievement of RAOs at LF-6.

7.8.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Remedial measures at Landfill 6 remain protective of human health and the environment under current exposures. Routine evaluation of environmental monitoring results should continue, with data analysis including identification of opportunities to streamline monitoring and reporting. Monitoring frequency should be significantly reduced, once arsenic is the only COC present above cleanup goals. The change in the regulatory standard for arsenic (23 µg/L, background value) should be noted in future long-term monitoring reports.

7.8.7 PROTECTIVENESS STATEMENT

Because all landfill wastes have been excavated and disposed of at Landfill 5 and a GMZ and other ICs have been established and maintained; the remedial action at LF-6 remains protective of human health and the environment.

7.8.8 REFERENCES

AFBCA, 2000. *USAF Site 6, Landfill 6, Demonstration of Remedial Actions Operating Properly and Successfully, Final.* (May)

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000a. *Landfill 6 Wetlands Third Annual Mitigation Monitoring Report Addendum.* (January)

Bechtel, 2000b. *Landfill 6 Operating Properly and Successfully Report.* (May)

Bechtel, 2000c. *Landfill 6 1999 Annual Report.* (June)

Bechtel, 2000d. *Landfill 6 Long-Term Monitoring Plan, Revision 1.* (November)

Bechtel, 2001. *Landfill 6 2000 Annual Report.* (April)

CH2M Hill, 1994. *Design Technical Memorandum, Pease Air Force Base Wetlands Improvement and Mitigation Scheme, Final Design for LF-6.* (October)

MWH, 2001b. *Landfill 6 2001 Annual Report.* (December)

MWH, 2002. *Preliminary Draft Landfill 6 2002 Annual Report.* (November)

MWH, 2003. *Landfill 6 Long-Term Monitoring Plan, Revision 2.* (July)

MWH, 2004. *Landfill and Construction Rubble Dump 2003 Annual Report.* (March)

NHDES, 2004. Inter-Department Communication from F. McGarry, Chief Engineer, Site Remediation Program, Subject: Revised GW-1 Groundwater Standards.

Weston, 1993a. *Zone 4 Remedial Investigation Report.* (September)

Weston, 1993b. *Base Zone 4 Feasibility Study Report.* (November)

Weston, 1993c. *Background Values for Soil, Groundwater, Surface Water, and Sediment at Pease Air Force Base.* (February)

Weston, 1995. *Record of Decision for Zone 4.* (January)

7.9 ZONE 5, SITE 8

7.9.1 BACKGROUND

7.9.1.1 Site Description

Site 8, the former Fire Department Training Area, is located in the northern portion of Pease AFB in the area designated as Zone 5 (Figure 7.9-1). Site 8 is bounded in the southeast by Site 11, the Field Maintenance Squadron Equipment Cleaning Area (FMS). Northwest of Site 8 is Site 9, the Construction Rubble Dump 1 (CRD-1). The town of Newington Center is north of the site, and Taxiway D is situated to the south. Undeveloped forested land, including the Newington Town Forest, is located along the eastern Site 8 boundary (Figure 7.9-2). The onsite offices of MWH and the Pease Administrative Record are housed in buildings/trailers located at the Site 8 treatment facility (MWH, 2003a).

Site 8 was an active fire training area from 1961 to 1988. The majority of fire training exercises were performed in a large circular pit area located in the southeastern section of the site. Small and large aircraft crash fires were simulated using up to 1,000 gallons (gal) of jet fuel (JP-4). Prior to 1971, mixed waste oils, solvents, and fuels were also disposed of at Site 8. The pit area was pre-saturated with water, and then the waste oils, solvents, and fuels were poured on top of the water and onto a mock aircraft. The mixture was allowed to burn for one to two minutes before being extinguished. In the mid-1970's, the practice of mixing waste oils and solvents with fuel for training fires ceased and only JP-4 was used (Weston, 1994).

Site 8 slopes toward the north from a high of approximately 117-ft above MSL in the southeast to approximately 50-ft above MSL to the north-northeast. Less than 10 ft of relief exists across the former burn areas. A bedrock outcrop exists in the southeastern part of the Site (Weston, 1992).

The overburden beneath Site 8 is comprised of approximately 70 ft of glacial deposits. The overburden glacial deposits consists primarily of the upper sand interfingers with the marine clay and silt where the marine clay and silt is present (Weston, 1994).

Groundwater is present in the overburden and in the bedrock. With the installation of the groundwater recovery/hydraulic containment system (See Section 7.9.2.3), overburden groundwater flows northeast toward the groundwater extraction wells. Depth to groundwater in the overburden of the source area is approximately 25-ft bgs.

Two groundwater capture zones are present in the overburden due to the pumping of the six overburden groundwater recovery wells. Total drawdown in the capture zones varies depending upon seasonal fluctuation in the water table. Despite seasonal water table fluctuations, groundwater capture is maintained throughout the year, insuring that contaminated groundwater is hydraulically contained and prevented from migrating northward and offsite.

Both metasedimentary and igneous bedrock underlies Site 8 and the bedrock consists primarily of metamorphosed sedimentary rocks of the Eliot Formation. The bedrock consists of weathered and/or fractured rock at shallow depth and competent deeper bedrock. Groundwater in the bedrock flows toward the west and northwest across the Site. Competent bedrock in the vicinity of the Site has negligible primary porosity; thus movement of groundwater in the competent bedrock is directly related to the bedrock structural fabric (bedding planes separations, foliation patterns, and fracture and join sets).

7.9.1.2 Initial Response

Several IRMs were implemented at Site 8 prior to execution of the record of decision. In February and March of 1990, approximately 262 tons of contaminated soil were removed from the drainage ditch located in the northeastern corner of the site. This drainage ditch received surface runoff form the former main burn pit. The soil removal was performed to avoid migration of contaminants from this highly contaminated soil to deeper soil and to groundwater. In August of 1990 a pilot groundwater extraction system was installed. The system was designed to mitigate offsite VOC migration and evaluate the pump and treat technique as a potential source control measure. Subsequent to the FS, a pilot scale SVE study was performed at Site 8 to evaluate the effectiveness of this technology to remediate site soils. Results were promising and were later used to establish design criteria for a full-scale system (Weston, 1994).

7.9.1.3 Basis for Taking Action

Remedial Investigation (1984- 1992): In 1983, an IRP Phase I Problem Identification/Records Search was conducted at Pease Air Force Base. As a result of the Phase I report and subsequent pre-survey work, an RI was conducted at Site 8 in accordance with CERCLA requirements. The RI was conducted in three stages from 1984 through 1992. Included in the third stage investigation were the IRMs discussed above, including removal of contaminated soil from the drainage ditch, a pilot-scale SVE study, and a pilot-scale groundwater remediation system (Weston, 1994).

Feasibility Study (1993): The Site 8 Feasibility Study (FS) estimated a total of 59,000 cubic yards (cy) of contaminated soil. The FS estimate was comprised of two components: in situ contaminated soil associated with two former burn pits areas (delineated using RI/FS soil sampling data), and light, non-aqueous phase liquid (LNAPL) contaminated soils associated with the smear zone (estimated using the more laterally extensive LNAPL plume). The FS determined that 42,000 cy of soils were associated with the former burn pits (each a column with 80-ft diameter and a vertical thickness of 20 ft). An additional 17,000 cy were estimated to be present in the LNAPL smear zone (5 ft vertical thickness) outside the burn pits (Weston, 1993).

7.9.2 REMEDIAL/REMOVAL ACTIONS

The following subsections describe remedial actions at Site 8.

7.9.2.1 Regulatory Actions

Record of Decision (1994):

The *Site 8 Record of Decision* (Weston, 1994) documented the selection of Alternative 4 which focused on source control and management of migration.

7.9.2.2 Remedial Action Objectives

RAOs were developed to mitigate the existing and future potential threats to human health and the environment via source control (soil vapor extraction, free product recovery) and management of migration of contaminated groundwater. The RAOs for Site 8 include:

- Protect ecological receptors from direct contact with, or ingestion of, soil containing contaminants in concentrations that may present an unacceptable risk;
- Prevent leaching of contaminants from soil to groundwater that would result in groundwater contamination that may present a health risk (total carcinogenic risk greater than 10^{-4} to 10^{-6}, or a hazard index greater than 1);
- Protect human receptors from ingestion of contaminated groundwater that may present a health risk (total carcinogenic risk greater than 10^{-4} to 10^{-6}, or a hazard index greater than 1); and
- Prevent discharge of contaminated groundwater to surface water bodies where it may present increased risks to human health and the environment (Bechtel, 1999).

7.9.2.3 Remedy Description

The Site 8 remedy as described in the ROD (Weston, 1994) included the following components:

- In situ SVE treatment of source area soil contaminated at concentrations exceeding cleanup goals and treatment of extracted soil vapor for removal of volatized organics.
- Construction of an asphaltic concrete cap to minimize rainfall and snowmelt infiltration into the area of SVE treatment. The cap would help to minimize the moisture content of the soil to be treated by SVE.
- Recovery and offsite disposal of free-phase product floating on the water table in the source area.
- Management of migration in the downgradient overburden water-bearing zone. Overburden recovery wells are located upgradient of the zone where contaminated overburden groundwater appears to migrate to the bedrock water-bearing zone. The groundwater recovery system was designed to capture overburden groundwater that is contaminated above cleanup goals, to prevent migration into the bedrock water-bearing zone.

- Construction of an onsite groundwater treatment plant (GWTP) for long-term treatment of recovered groundwater. Treated groundwater is discharged to subsurface recharge trenches.

- Environmental monitoring, including groundwater sampling, groundwater elevation monitoring, surface water (including wetlands) monitoring, and soil contamination monitoring, during remedial operations.

- Long-term environmental monitoring, including groundwater, surface water, and sediment sampling and analysis.

Site 8 soil and groundwater clean-up goals are summarized in Table 7.9-1and Table 7.9-2, respectively.

7.9.2.4 Remedy Implementation

The start-up date for the Site 8 Remediation Facility was September 20, 1995 (pilot scale), with full-scale operation beginning on October 5, 1995. The Site 8 remedial action consists of hydraulic containment with groundwater treatment and SVE. Both extraction remedies have above-ground treatment facilities.

The groundwater extraction and treatment system includes:

- 6 overburden extraction wells north and downgradient of the source area;

- A groundwater treatment plant (oil/water separation, green sand filtration [only on an as-needed basis, or immediately after performing system maintenance], air stripping, and carbon adsorption); and,

- 5 subsurface trenches used to discharge the treated effluent.

Figure 7.9-3 presents a flow diagram for the Site 8 treatment system.

The SVE system consists of:

- 189 extraction wells;

- 121 passive air supply vents (ASVs);

- An extensive above-ground pipe manifold;

- 4 moisture separators;

- 3 vacuum blowers;
- A catalytic oxidation unit (now bypassed); and,
- 2 vapor-phase granular activated carbon units.

Figure 7.9-5 presents the SVE remedial system layout for Site 8.

Performance data are collected and analyzed on an annual basis to estimate mass removal by the remedial system at Site 8. The following table summarizes performance data for the period 1996 through 2003 (MWH, 2004).

Total pounds removed by method and year

	1996	1997	1998	1999	2000	2001	2002	2003	Totals
SVE Vapor Phase (and DPE)	139,000	38,000	7,800	3,200	4,050	2,640	5,500	2,430	202,620
Groundwater - SVE, extraction	8,000	1,300	100	20	10	60	20	30	9,540
LNAPL Recovery (all sources)	1,600	21,700	18,000	24,900	23,500	7,700	3,600	1,300	102,300
Sludge	400	800	300	1,800	1,900	4,100	1,700	1,700	12,700
Total	149,000	61,800	26,200	29,920	29,460	14,500	10,820	5,460	327,160

As this table indicates, contaminant recovery has experienced a nearly exponential decrease since 1996. This decline is typical of remediation system progress.

Soil sampling was performed during 2001 to characterize the current extent of soil contamination. Based on the 2001 soil sampling effort, 22,375 cy of contaminated soil were estimated to be remaining at Site 8, representing a 62 percent reduction in the volume of contaminated soil reported in the FS. The greatest reduction in contamination has been associated with the vertical extent of soil contamination. Year 2001 soil boring logs and photoionization detector (PID) headspace readings for volatile organics indicated that the unsaturated soils at Site 8 are generally clean and that a one to two order of magnitude reduction in VOCs has typically occurred within a couple feet above the groundwater interface. These data suggest that the SVE system at Site 8 has successfully cleaned unsaturated soils. Therefore, residual contamination at Site 8 is associated with saturated soils and smear zone near the LNAPL plumes. Numerous system modifications and operational changes have been made through the years to optimize recovery of contamination (See operations reports listed in Section 7.9.3 below), with great success. However, it appears that most practical optimizations of the system as it is currently configured have now been made, and the rate of contaminant removal is leveling off.

In 2002, a dual-phase extraction (DPE) pilot test was conducted on well 7959 during May through November 2002. This pilot study utilized pneumatically powered, total fluids pumps installed in existing wells. A portion of the LNAPL was collected and recovered in the liquid state, and a portion was volatilized and captured by the SVE system. Preliminary trials indicated that the DPE could significantly enhance mass removal rates. The DPE pilot was then expanded to three additional wells within the source. Because of cold weather and freezing risks to the above-ground piping, the pumps were removed for the season on November 26, 2002 and were replaced in the wells on April 21, 2003. DPE pumps operated continuously throughout the 2003 season until they were removed on November 5, 2003. Analysis of the data indicated that the DPE wells represented approximately 6 percent of the operating wells and provided less than 2 percent of the vapor mass removal during the time of operation. DPE does not appear to have been successful but may merit some further consideration for spot removal of LNAPL.

The *Site 8 Long-Term Monitoring Plan, Revision 2* requires sampling of 32 groundwater monitoring wells for volatile organic compounds (VOCs) and intrinsic remediation (IR) parameters. Three of those locations are also sampled for target metals. One surface water sampling location is also be monitored annually for VOCs (MWH, 2003b).

In 2003, only benzene, naphthalene, 1,2,4-trimethylbenzene, and vinyl chloride exceeded the cleanup goal in more than one monitoring well. Total alkylbenzenes also exceeded the NHAGQS (no cleanup goal specified). These exceedances occurred only within the GMZ. No wells on the GMZ or offsite contained greater than trace concentrations of organic constituents, confirming that the site remediation is successfully preventing offsite migration. The extent of free product detected in 2003 and the approximate extent of the groundwater plume are illustrated on Figure 7.9-2.

Lead and thallium were not detected in the monitored wells. In 2003, as in previous years, manganese and arsenic were both detected at concentrations in excess of the specified limit.

These exceedances have generally been limited to the source area and the area of groundwater extraction, and have been contained within the GMZ boundary.

Surface water and sediment monitoring to meet the remedial objectives of the Site 8 ROD are conducted as part of the Pease Basewide Surface Water and Sediment Monitoring Program, and are described in Section 9.6 of this *Five-Year Review Report*.

LUC/ICs are in place for Site 8 in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property (PDA). The deed implemented several LUC/IC measures. These include a GMZ prohibiting use of groundwater and a URZ prohibiting both residential use and establishment of child care facilities, playgrounds or elementary/secondary schools. The deed established the Site 8 GMZ as an ASN requiring concurrence from the Air Force for any development within the GMZ and specifically prohibits any activity that could disturb ongoing remedies. The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.9.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedy for Site 8 remained protective of human health and the environment. The following recommendations were included in the *Five-Year Review* (Bechtel, 1999):

- Continue to operate the remedial system in accordance with EPA and NDHES-approved plans for operation, maintenance, and monitoring;
- Perform annual evaluation of system operations and environmental monitoring to identify opportunities to optimize system operation and refine long-term monitoring activities; and
- Perform annual evaluations of contaminant trend removal, economics of system operation, and level of progress toward cleanup goals, including developing an estimate of time-frame to completing remediation.

Annual evaluation of system performance, progress toward cleanup goals, and optimization efforts were documented in the following:

- *Site 8 Optimization Evaluation.* Bechtel, 2000 (February).
- *Site 8 Fourth Year Operations Report.* Bechtel, 2000 (April).
- *Site 8 Revised Long-Term Monitoring Plan.* Bechtel, 2000 (April).
- *Site 8 Remediation System Operating Properly and Successfully Report.* Bechtel, 2000 (July).
- *Site 8 Remediation System Fifth Year Operations Report.* Bechtel, 2001 (March).
- *Site 8 Remediation System Sixth Year Operations Report.* MWH, 2002 (May).
- *Pilot Study Work Plan, Site 8 (FDTA-2) Dual Phase Extraction System Optimization.* MWH, 2002 (December).
- *Site 8 Remediation System Seventh Year Operations Report.* MWH, 2003 (April).
- *Site 8 Long-Term Monitoring Plan, Revision 2.* MWH, 2003 (June).
- *Site 8 Operations and Maintenance Plan, Revision 5.* MWH, 2003 (October).
- *Site 8 Eighth Year Operations Report.* MWH, 2004 (April).

7.9.4 TECHNICAL ASSESSMENT

7.9.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of performance and long-term monitoring data collected for Site 8 since the last 5-year review indicates that the components of the remedy at Site 8 are functioning as intended. The hydraulic containment and GMZ components of the remedy have successfully restricted groundwater use within the areas affected by Site 8 contaminants and ensured that those contaminants are not migrating outside of Site 8 to downgradient receptors. Additionally, the SVE system has successfully removed soil contamination and free product from the vadose zone at Site 8, and there has been substantial improvement in groundwater quality at the site. Soil confirmation sampling performed in 2001 indicates that the volume of contaminated soil estimated to remain at Site 8 has been reduced by 62 percent from that reported in the FS.

7.9.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards : ARARs are now available for several groundwater constituents that were assigned TBC or risk-based cleanup standards in the *Site 8 ROD*. Revised cleanup goals are summarized in the following table.

Constituent	ROD Cleanup Goal (μg/L)/Basis	ARAR Change/Basis
Sec-butylbenzene	7.3 /Risk-based	260 / NHAGQS
4,4-DDD	0.177 /Risk-based	0.1 /NHAGQS
1,2-Dibromoethane	0.000501 /Risk-based	0.05 / NHAGQS
Isopropylbenzene	89.1 / Risk-based	280 / NHAGQS
1,2,4-Trimethylbenzene	19.8 /Risk-based	330 /NHAGQS
2-Methylnaphthalene	12.4 /Risk-based	280 /NHAGQS
4-Methylphenol	350 /NHDPHS	350 /NHAGQS
Phenanthrene	12.4 /Risk-based	210 /NHAGQS
Arsenic	50 /MCL	10 /MCL*

* - A background value of 23 μg/L for arsenic has been established at Pease.

The risk-based cleanup goal listed in the ROD has already been met for 4,4-DDD, 1,2-dibromoethane, 2-methylnaphthalene, and phenanthrene. The TBC-based goal for 4-methylphenol has also been met. Based upon recent groundwater monitoring data, the current ARARs for sec-butylbenzene, isopropylbenzene and 1,2,4-trimethylbenzene would be achieved at the adoption of the ARARs, whereas exceedances of the ROD specified risk-based cleanup goals have existed at Site 8 for these compounds. The MCL for arsenic was reduced from 50 μg/L to 10 μg/L. The Pease background value for arsenic is 23 μg/L. Therefore, a cleanup goal of 23 μg/L is more appropriate than the revised MCL.

Changes in Exposure Pathways: There have been no changes in physical site conditions, land use, or exposure pathways that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Soil cleanup standards are based on a leaching model designed to be protective of groundwater. The values shown in the *Site 8 ROD* are conservative, when compared to published values for soil, i.e., the NHDES S-1 values. ARARs, e.g., NHAGQS, are now available for several of the constituents for which risk-based groundwater cleanup standards were listed in *the Site 8 ROD*, as shown above.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA and EPA Region 1 guidance. There has not been any significant change in EPA guidance which could result in significant revisions to cleanup goals. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: The current remedial system is meeting RAOs associated with removal of contaminants from the vadose zone and preventing exposure to contaminants at concentrations of concern. The rate of contaminant mass removal has declined and it will likely take a significant amount of time to achieve cleanup goals.

7.9.4.3 Question C

Question C: Has any other information come to light that could call into questioned the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.9.4.4 Technical Assessment Summary

As described above, the components of the Site 8 remedy are functioning as intended. While changes in ARARs have affected groundwater cleanup levels, these changes have not impacted the current protectiveness of the remedy, based on site-specific groundwater monitoring data. Current concentrations of the organic constituents sec-butylbenzene, isopropylbenzene and 1,2,4-trimethylbenzene exceed the Site 8 ROD risk-based concentrations, but are less than the ARARS that now exist for these compounds. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. While the rate of contaminant mass removal has declined and it will likely take a significant amount of time to achieve cleanup goals, the remedy is currently progressing toward achievement of RAOs. LUC/ICs are in place and performing as expected. No other information has come to light that would call into question the protectiveness of the remedy.

7.9.5 ISSUES

Mass removal within the source area has declined and a lengthy time period will likely be required to achieve final remedial goals. ARARs (NHAGQS) are now available for several groundwater COCs for which TBCs or risk-based values were used to set cleanup goals in the ROD. Current concentrations of the organic constituents sec-butylbenzene, isopropylbenzene and 1,2,4-trimethylbenzene are above the ROD risk-based clean up goals, but are less than the ARARs that now exist for these compounds.

7.9.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine long-term monitoring and groundwater extraction at Site 8 should continue. An alternatives analysis will be prepared by the Air Force during calendar year 2004 to evaluate methods of remediating remaining LNAPL and saturated zone contamination that is difficult to remove with the current SVE system. Routine data evaluation of groundwater flow conditions, trends in groundwater quality and the occurrence of LNAPL should be performed to assess system performance and optimize long-term monitoring activities. The changes in the regulatory standards for Site 8 COCs listed in Section 7.9.4.2 should be noted in future long-term monitoring reports.

7.9.7 PROTECTIVENESS STATEMENT

The current remedy at Site 8 is protective of human health and the environment and prevents unacceptable exposures through groundwater containment and ICs.

7.9.8 REFERENCES

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000. *Site 8 Optimization Evaluation.* (February)

Bechtel, 2000. *Site 8 Fourth Year Operations Report.* (April)

Bechtel, 2000. *Site 8 Revised Long-Term Monitoring Plan.* (April)

Bechtel, 2000. *Site 8 Remediation System Operating Properly and Successfully Report.* (July)

Bechtel, 2001. *Site 8 Remediation System Fifth Year Operations Report.* (March)

MWH, 2003a. *Site 8 Fact Sheet.*

MWH, 2003b. *Site 8 Long-term Monitoring Plan, Revision 2.* (June)

MWH, 2002. *Site 8 Remediation System Sixth Year Operations Report.* (May)

MWH, 2002. *Pilot Study Work Plan, Site 8 (FDTA-2) Dual Phase Extraction System Optimization* (December)

MWH, 2003. *Site 8 Remediation System Seventh Year Operations Report.* (April)

MWH, 2003. *Site 8 Operations and Maintenance Plan, Revision 5.* (October)

MWH, 2004. *Site 8 Eighth Year Operations Report.* (April)

Weston, 1992. *Stage 3C IRP Site 8 Remedial Investigation.* (November)

Weston, 1993. *Stage 3C Feasibility Study for Site 8.* (January)

Weston, 1994. *Record of Decision for Site 8.* (September)

7.10 ZONE 7, SITE 45

7.10.1 BACKGROUND

7.10.1.1 Site Description

The Old Jet Engine Test Stand (OJETS) was constructed (circa 1958) near the southwestern edge of the runway at the former Pease AFB (Figure 7.10-1). The OJETS encompasses approximately 0.6 acres, and is located in IRP Zone 7 and the PDA natural resource protection zone. The facility consisted of a partially enclosed test stand, an engine control room, a transformer, an in-ground exhaust crib, and a 2,500-gallon fuel storage tank (Figure 7.10-2).

PDA recently expanded the 18-hole Pease Golf Course to 27 holes. The nine-hole expansion impacted an area of approximately 100 acres, including Site 45 (Figure 7.10-3). The area, bordered on the south by the existing golf course and on the north by the airport fence, is approximately 6,000 feet long by 500 feet wide running parallel to the runway. No change from this land use is expected within the foreseeable future.

Site 45 is located on the western edge of a broad, topographically high ridge of unconsolidated sands and gravels that trends northwest-southeastward across the Newington Peninsula (Weston, 1995). Groundwater is encountered at the site within the US-LS/glacial till units. These two hydrostratigraphic units are separated over most of the site by a marine clay and silt (MSC) aquitard that is generally thin (< 6 feet) and locally sandy. Where the aquitard is totally absent, there is less resistance to vertical groundwater flow; consequently, the US and glacial till units act as a single hydrostratigraphic unit.

Groundwater flow within the US unit is westward. The flow pattern is consistent with the regional topography and similar to the west-northwestward groundwater flow direction observed at other Pease AFB sites in the area (MWH, 2003).

In the mid-1960s, the test stand operated at full capacity for the majority of the time. During testing, the engine exhaust was directed out of the northern end of the containment structure toward the rock crib, which was designed to deflect the engine exhaust. Petroleum products, hydraulic fluids, and solvents were reportedly used extensively at the facility before the

OJETS was taken out of service in 1976. After the OJETS was removed from service, the engine control room, aboveground fuel storage tank, and transformer were removed. In 1992, as part of the RI, the OJETS building, concrete pad, and rock crib were removed.

Figure 7.10-4 shows the area of historical and current groundwater contamination.

7.10.1.2 Initial Response

No remedial actions were performed at Site 45 prior to the finalization of the *Site 45 Record of Decision* (Weston, 1995).

7.10.1.3 Basis for Taking Action

Remedial Investigation/Feasibility Study (1992-1993): Under the IRP, a site inspection (SI) and RI/FS (Weston, 1993) were conducted at Site 45 between October 1992 and January 1993. An evaluation of the organic contamination distribution in the soil suggested that the source of contamination was leakage of aviation gasoline (AVGAS) and the exhaust of combustible by-products during testing. The irregular distribution and low concentrations of chlorinated VOCs imply that only minor amounts of degreasing solvents were used to clean jet engine parts and that only small quantities of these solvents were spilled or otherwise released. The engine testing was also considered as a potential origin of the metals contamination that has been identified in the surface soil; the actual source is undetermined.

Treatability Study (1994): A pilot-scale SVE/AS treatability study was conducted at Site 45 between September 12 and November 3, 1994. The objectives were to evaluate the effectiveness of SVE/AS as a cleanup method at the site and establish design criteria for a full-scale system. The results of the pilot test indicated that SVE and AS were effective technologies for remediation of the soil at the site.

7.10.2 REMEDIAL/REMOVAL ACTIONS

The following subsections describe regulatory actions and remedial actions performed at Site 45.

7.10.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Record of Decision (1995):

The *Site 45 Record of Decision* (Weston, 1995) documented selection of Alternative 3, which included removal of contaminated soils, air sparge/soil vapor extraction, and institutional controls.

7.10.2.2 Remedial Action Objectives

RAOs identified in the *Site 45 Record of Decision* (Weston, 1995) include:

- Protect ecological receptors from ingestion of surface soils and vegetation containing contaminants at concentrations that may present an unacceptable risk;
- Protect human receptors from ingestion of contaminated groundwater that may present an unacceptable health risk in exceedance of EPA's risk range of 10^{-4} to 10^{-6} total cancer risk) for a future off-base resident, or a hazard index greater than 1; and
- Comply with location- and action-specific ARARs, to be considered (TBC) criteria, and/or established background levels for specific contaminants in soil, as appropriate.

7.10.2.3 Remedy Description

The Site 45 remedy was designed to remove soil contaminants that had the potential to leach to, and contaminate, groundwater. In summary, the remedy included the following actions:

- In situ AS of saturated contaminated soil to enhance volatilization and biodegradation of organic contaminants in soil and groundwater;
- In situ SVE treatment of unsaturated contaminated soil to extract VOCs and to enhance biodegradation of organic contaminants;
- Installation of a low-permeability membrane on the ground surface over the area to be treated by SVE/AS to minimize the potential for short circuiting of atmospheric air to the SVE vents;

- Natural attenuation of residual contamination remaining in groundwater after excavation and in conjunction with SVE/AS treatment; and
- Institutional controls, including placement of security fence and monitoring of site groundwater until cleanup goals have been attained.

Clean up goals for soil and groundwater as established in the *Site 45 ROD* (Weston, 1995) are summarized in Table 7.10-1 and Table 7.10-2, respectively.

7.10.2.4 Remedy Implementation

Following completion of the treatability study, operation of the pilot AS/SVE system was continued on an interim basis through May 1995. The purpose of the interim operation was to continue remediation of the soils in areas known to be within the ROI.

AS and SVE well installation activities for full-scale operation were performed during November and December 1995. The SVE system consisted of one horizontal and eight vertical wells. The AS system consisted of 30 vertical wells. The mechanical and emission treatment systems were installed during June and July 1996.

System startup was initiated in August 1996. The remedial system operated for approximately two months before it was shut down in October 1996 due to high water table conditions. In July 1997, two soil borings were completed in the most highly contaminated areas of the site. Results from the analysis of those samples, as well as the results obtained during installation of the AS and SVE wells, indicated that soil remediation objectives had been attained.

Of the seven organic groundwater COCs (2-methylnaphthalene, sec-butylbenzene, benzene, cis-1,2-DCE, isopropylbenzene, 1,2,4-trimethylbenzene, and naphthalene), all but 2-methylnaphthalene and sec-butylbenzene have been consistently below the regulatory limit in all monitored wells for at least the last seven sampling rounds. (MWH, 2003). Recent sampling data have demonstrated that all monitored organic COCs (including 2-methylnaphthalene and sec-butylbenzene) in groundwater have declined to levels below the clean-up goals.

As prescribed by the *Revised Long-Term Monitoring Plan* (MWH, 2001b), eight wells were sampled for a reduced list of COC, which includes two organic COCs (2-methylnaphthalene and sec-butylbenzene) during 2003. None of the monitored wells contained sec-butylbenzene levels above the cleanup goal of 7.3 µg/l either in the May 2003 sampling event or in the previous sampling events in May 2001 and May 2002. 2-methylnaphthalene was detected in one well in May 2003 at a concentration of 12 µg/l, which is slightly below the cleanup goal of 13.4 µg/l and less than the result detected in May 2002 (16 µg/l). 2-methylnaphthalene has not been detected above the cleanup goal in any other well since December 1999 when one well had a 2-methylnaphthalene value of 14 µg/l. (Note: ARARs [NHAGQS] that significantly elevate cleanup goals for 2-methylnaphthalene and sec-butylbenzene are now available; see Section 7.10.4.1 below.)

Although both lead and manganese have designated cleanup goals in the *Site 45 ROD* (Weston, 1995), lead has not been detected above the cleanup goal of 15 µg/l since 1993. Manganese however, is consistently detected above the ROD cleanup goal of 1500 µg/L in Site 45 monitoring wells.

Manganese was not an apparent constituent of any wastes or spills associated with historical activities at the OJETS facility. Rather, its presence in the subsurface reflects biological and geochemical conditions related to the biodegradation of the petroleum hydrocarbons in the soil and shallow groundwater. Elevated manganese concentrations are associated with the area of suspected active biodegradation (i.e., the source area). This suggests that the manganese levels observed at Site 45 are a by-product of natural attenuation at the Site. Re-equilibration of the groundwater system downgradient of the attenuation zone is projected to eventually reduce manganese concentrations to below the cleanup goal. While initial statistical analyses indicate that manganese cleanup goals would not be achieved until approximately 2014, a statistically significant downward trend in concentration was observed (MWH, 2003).

LUC/ICs are in place for Site 45 in the form of restrictions in the deed, which was executed between the Air Force and the current owner of the property (PDA). The deed implemented several LUC/IC measures. These include a GMZ prohibiting use of groundwater and a URZ prohibiting both residential use and establishment of child care facilities, playgrounds or elementary/secondary schools. The deed established the Site 45 GMZ as an ASN requiring concurrence from the Air Force for any development within the GMZ and specifically prohibits any activity that could disturb ongoing remedies. The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.10.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedy for Site 45 remained protective of human health and the environment. The following recommendations were included in the *Five-Year Review* (Bechtel, 1999):

- Continue long-term monitoring as needed to confirm remediation of the source area and track progress of natural attenuation;
- Optimize groundwater monitoring as appropriate, based on success of SVE/AS in remediation of the source area; and
- Develop timeframe for site closeout (anticipated occurring before the second Five-Year Review).

Long-term monitoring and progress toward cleanup goals were documented in the following:

- *Site 45 1999 Status Report.* Bechtel, 2000b (May)
- *Site 45 2000-2001 Status Report.* Montgomery Watson, 2001a (September)
- *Site 45 2002 Annual Report.* MWH, 2002 (October)
- *Site 45 2003 Annual Report.* MWH, 2003 (October)

Documentation of the Site 45 remedy operating properly and successfully was presented in:

- *Site 45 Demonstration of Remedial Actions Operating Properly and Successfully.* Bechtel, 2000a (April)

Optimizations of the long term monitoring plan were documented in:

- *Site 45 Revised Long-Term Monitoring Plan.* Montgomery Watson, 2001b (November)

Closure of the SVE/AS remedial system was documented in:

- *Site 45 Remedial System Closure Report.* Bechtel, 2001 (January)

Soil cleanup goals were achieved at the site, as documented in Bechtel, 2001. However, site closeout was not achieved prior to this Five-Year Review, as described above in remedy implementation.

7.10.4 TECHNICAL ASSESSMENT

The technical assessment portion of the Five-Year Review evaluates the protectiveness of the remedy. The following subsections address the specific questions outlined in EPA's *Comprehensive Five-Year Review Guidance* (EPA, 2001).

7.10.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

Based on a review of documents, ARARs, and risk assumptions, the remedy at Site 45 is functioning as intended. Soil cleanup levels were attained by the AS/SVE system (Bechtel, 2001). Organic constituents in groundwater have declined below ROD-specified cleanup goals as of 2003. ICs, including a GMZ, are in place and maintained. Manganese concentrations in the source area remain above the ROD-specified cleanup goal, with some wells exhibiting a slight downward trend.

7.10.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards:</u>

Soil Cleanup Goals. Soils at Site 45 were remediated to the cleanup goals specified in the *Site 45 ROD*. There have been some minor changes to the standards used to derive the Site 45 cleanup goals for soil. . In all cases, the revisions resulted in less stringent standards than those specified in the ROD. These changes were the result of NHDES policy changes, and do not affect the protectiveness of the remedy.

Groundwater Cleanup Goals. Groundwater cleanup goals in the *Site 45 ROD* were based on ARARs, except where ARARs were not available. Of the nine constituents for which cleanup goals were established, ARARs were used for benzene, cis-1,2-DCE, napthalene, and lead. ARARs included Federal Safe Drinking Water Act MCLs, New Hampshire Drinking Water Quality Standards (Env-Ws 316, 317, and 318), and New Hampshire Ambient Groundwater Quality Standards (Env-Wm 1403). These ARARs remain current.

New Hampshire AGQS have been established for 2-methylnaphthalene, sec-butylbenzene, isopropylbenzene, and 1,2,4-trimethylbenzene. The established NHAGQS (280 μg/L, 260 μg/L, 280 μg/L and 330 μg/L, respectively) are significantly higher than the risk-based levels included in the *Site 45 ROD* (see table below). Recent groundwater monitoring data indicate that concentrations of these COCs at Site 45 are below the ROD-specified cleanup goals, and are well below the recently-established ARARs (NHAGQS). Concentrations have not been reported above the newly established NHAGQS since 1994. Therefore, the changes in NHAGQS do not have a negative impact on the protectiveness of the remedy.

Changes in Exposure Pathways: PDA recently expanded the 18-hole Pease Golf Course to 27 holes. The nine-hole expansion impacted an area of approximately 100 acres, including Site 45 (Figure 7.10-3). Because site soils were remediated to concentrations below the current residential NHDES S-1 standards, and because groundwater use is restricted by the GMZ, the protectiveness of the remedy is not impacted by the current site use.

Changes in Toxicity and Other Contaminant Characteristics: Recently established NHAGQS for 2-methylnaphthalene, sec-butylbenzene, isopropylbenzene, and 1,2,4-trimethylbenzene are higher than ROD-specified Site 45 groundwater cleanup goals. Therefore, changes in toxicity and other contaminant characteristics do not negatively impact the protectiveness of the remedy.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA and EPA Region 1 guidance. There has not been any significant change in EPA guidance that could result in significant revisions to cleanup goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals.

<u>Expected Progress Toward Meeting RAOs:</u> The remedy has achieved cleanup goals in soil, and therefore has achieved RAOs associated with preventing unacceptable exposure to soils. The remedy has currently achieved cleanup goals for organic constituents in groundwater. It is expected that the remedy will attain inorganic groundwater cleanup goals over time.

7.10.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.10.4.4 Technical Assessment Summary

The remedy at Site 45 is functioning as intended. Soil cleanup levels were attained by the AS/SVE system (Bechtel, 2001). Organic constituents in groundwater have declined below ROD-specified cleanup goals as of this year, and are significantly below updated groundwater ARARs for COCs. No changes in exposure pathways are affecting the protectiveness of the remedy. No other information has come to light that would call into question the protectiveness of the remedy.

7.10.5 ISSUES

No issues were identified for Site 45.

7.10.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Remedial measures at Site 45 remain protective of human health and the environment under current exposures. Routine evaluation of environmental monitoring results should continue, with data analysis including identification of opportunities to streamline monitoring and reporting.

7.10.7 PROTECTIVENESS STATEMENT

Because of the remedial action at Site 45 (implementation of the AS/SVE system) and ICs, including the GMZ, the site is protective of human health and the environment. The site is expected to be protective in the future, as progress is made toward achievement of cleanup goal for the remaining groundwater COC (manganese).

7.10.8 REFERENCES

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000a. *Site 45 Demonstration of Remedial Actions Operating Properly and Successfully.* (April)

Bechtel, 2000b. *Site 45 1999 Status Report.* (May)

Bechtel, 2001. *Site 45 Remedial System Closure Report.* (January)

EPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

Montgomery Watson, 2001. *Site 45 2000-2001 Status Report.* (September)

Montgomery Watson, 2001. *Site 45 Revised Long-Term Monitoring Plan.* (November)

MWH, 2002. *Site 45 2002 Annual Report.* (October)

MWH, 2003. *Site 45 2003 Annual Report.* (October)

Weston, 1993. *Site 45 Remedial Investigation/Feasibility Study Report.* (December)

Weston, 1995. *Site 45 Record of Decision.* (August)

7.11 ZONE 3, SITE 73

7.11.1 Background

7.11.1.1 Site Description

Site 73 is located in Zone 3 in the central portion of the former Pease AFB (See Figure 7.11-1). Site 73 includes Building 234 and surrounding driveways and grassy areas, as well as areas associated with a groundwater chlorinated VOC plume. Building 234 (unoccupied), where the plume begins, is located on Airline Avenue between Exeter Street to the south and Site 76 to the north. (See Figure 7.11-2). Adjacent sites include Building 239 (UST Site 79), Base Motor Pool (UST Site 72), Building 136 (UST Site 81), and the airport passenger terminal across airline avenue.

Land use in the area of the downgradient plume includes airport terminal parking and private commercial properties. Site 73 lies within the Zone 3 GMZ, and land use is restricted as described in the *Zone 3 Record of Decision Amendment* (MWH, 2003d).

Under a 1 to 14 feet thick layer of silty sandy fill, the overburden is comprised primarily of sand representing the undifferentiated Upper and Lower Sand Units that occur across the Base. The MCS Unit that separates the two sand units elsewhere at Pease AFB is absent in the vicinity of the Site 73 source area, but the unit is present in the downgradient areas of the plume. The MCS thickens to the east, to the point where it replaces the upper and lower sand units near the eastern terminus of the plume. Glacial till underlies the sandy overburden and is comprised of a poorly sorted mixture of gravel, sand, and silt. Where present, the till unit ranges in thickness up to 10 feet. The underlying bedrock consists of metamorphic phyllite and diabase intrusive rocks and is variably fractured and weathered in its upper 10 to 15 feet.

Groundwater at Site 73 is encountered at a depth of approximately 6-feet below ground surface (bgs). Historical groundwater elevation data have indicated that groundwater flows in a southerly direction in the vicinity of the Site 73 source area and PRB and then flow direction changes to a southeasterly or even easterly direction in the downgradient portion of the plume. Horizontal linear groundwater velocities for both the overburden soils and shallow bedrock hydrogeologic units near the Building 234 range from 0.12 to 0.96

feet per day (ft/day). Shallow bedrock linear velocity ranges from 0.25 to 0.31 ft/day (MWH, 2004b).

Building 234 was constructed in 1959 and was originally used as a liquid oxygen plant. In 1978, it was converted to house a water demineralization plant. Air Force records for Site 73 indicate that TCE and PCE were used as solvents and degreasers at Building 234. TCE was in common use at Pease from about 1956 and was reportedly used at Building 234 until 1978. Cleaning and degreasing operations were conducted in the vicinity of the concrete area northeast of Building 234, with discharges to the environment apparently occurring in the form of minor spills or runoff associated with these operations.

Figure 7.11-3 shows the area of historic groundwater contamination, the wells in the long-term monitoring network.

7.11.1.2 Initial Response

Site 73 was originally investigated under the UST program at the former Pease AFB. The site contained two 1,000-gal fuel oil tanks; one tank was removed in 1989 and the other in 1991. Remedial activities under the UST program included the excavation and disposal of approximately 150 tons of contaminated soil from the areas surrounding the former USTs. Because of the presence of chlorinated VOC compounds in groundwater, the site was transferred to the IRP. Site 73 was under investigation at the time of the *Zone 3 ROD* (Weston, 1995). Remedial actions at Site 73 were later documented in the *Zone 3 ROD Amendment* (MWH, 2003d).

7.11.1.3 Basis for Taking Action

Zone 3 Remedial Investigation Report, Addendum 2, Site 73 Site Investigation (SI) (1994): SI activities focused on identifying the source and extent of chlorinated VOCs in soil and groundwater at Site 73 (Weston, 1994). The SI concluded that impacted soils had been removed during UST investigations and the SI, and indicated the need for additional trenching and sampling along a former drainage ditch near the suspected source area. A single extraction well was installed as an interim remedial measure for impacted groundwater.

Site 73 Remedial Investigation and Feasibility Study (RI/FS) (1996): The RI/FS was completed in 1996 (Weston, 1996) as part of the CERCLA process. The Site 73 groundwater plume was found to be composed primarily of TCE and its degradation products. From the vicinity of Building 234, the plume extends southward, beneath Airline Avenue to the parking lot of the PDA passenger terminal, and continues south beyond Exeter Street to a wooded area containing a wetland and remnants of an abandoned water supply well field (circa 1940). Beneath the wooded area, the plume turns eastward, passing along the southern boundary of Site 81 and between Buildings 229 and 123. South of Building 123, the plume historically turned slightly northeastward before ending in a wooded area north of Building 122. The total length of the plume was historically approximately 2,200 feet. However, the most recent analytical data (2003) indicate that concentrations above the Zone 3 RGs are limited to an area approximately 1,300 ft downgradient of Building 234 (MWH, 2004b).

7.11.2 REMEDIAL/REMOVAL ACTIONS

The following subsections describe regulatory actions and remedial actions performed at Site 73.

7.11.2.1 Regulatory Actions

Presented below are the documents affecting remedy selection at Site 73:

Zone 3 Record of Decision Amendment (2003)

The *Zone 3 ROD Amendment* (MWH, 2003d) formally documented the response action implemented at Site 73 to be consistent with CERCLA of 1980, as amended, and NCP. The response action activities documented in the ROD Amendment included:

- In-situ groundwater treatment with a zero valent iron PRB;
- Monitored natural attenuation of the groundwater contaminant plume down-gradient of the PRB; and
- Implementation of a long-term performance monitoring plan.

7.11.2.2 Remedial Action Objectives

The *Zone 3 ROD Amendment* (MWH, 2003d) identified the following general Zone 3 RAOs relevant to Site 73:

- Protect human receptors from ingestion of, or direct contact with, contaminated groundwater that may present an unacceptable health risk;
- Comply with chemical-specific ARARs; and
- Prevent discharge of contaminated groundwater to surface water bodies where such discharges may cause unacceptable risks to human health and the environment.

Groundwater Restoration Goals for groundwater at Site 73, as presented in the *Zone 3 ROD Amendment* (MWH, 2003d), are listed in Table 7.11-1.

7.11.2.3 Remedy Description

The response action activities documented in the ROD Amendment included:

- In-situ groundwater treatment with a zero valent iron PRB;
- Monitored natural attenuation of the groundwater contaminant plume down-gradient of the PRB; and
- Implementation of a long-term performance monitoring plan.

In addition, the *Zone 3 ROD Amendment* (MWH, 2003d) noted the implementation of ICs as a component of the Site 73 remedy. ICs are the non-technical non-engineering actions, which support or complement the implementation of cleanup actions required by the remedy. Implementation, monitoring, and enforcement of the selected ICs are used to ensure protection of human health and the environment at property encompassed by Site 73. The goals of the ICs are designed to be protective of human health and the environment and include:

- Prevent exposure to contaminated soil;
- Prevent exposure to contaminated groundwater;
- Protect the integrity of the Site 73 PRB and monitoring well networks.

7.11.2.4 Remedy Implementation

A limited groundwater quality profiling investigation was performed in the summer of 1996 (Johnson, 1996) to determine the extent of the chlorinated solvent plume from Site 73. Supplemental profiling was performed in the fall of 1996 in an unsuccessful attempt to define the downgradient edge of the plume (Johnson, 1997). Bechtel Environmental, Inc. (Bechtel) continued to perform additional characterization activities in 1997 to investigate the potential for DNAPL in the source area (none was found), characterize shallow bedrock groundwater conditions, and to define the downgradient portions of the plume. Results from this supplemental characterization activity were used to evaluate remedial alternatives, and it was determined that a PRB would be a technically feasible remedial option at Site 73.

A siting study was completed in March 1999 to provide a detailed understanding of the hydraulic, geotechnical, and geologic conditions at the proposed PRB location as needed to support the design and installation of the PRB. Results from this effort, which involved the collection of data to quantify soil engineering properties, hydraulic parameters in the soil and bedrock, lithology, and contaminant distribution, were presented in the *Technical Memorandum for the Permeable Reactive Wall Siting Study* (Bechtel, 1999a). Additionally, Bechtel performed groundwater flow measurements in the vicinity of the PRB following the conclusion of remedial activities at Site 73. The results are discussed in the *Technical Memorandum for Groundwater Flowmeter Measurement Results at Pease AFB* (Bechtel, 2001a).

In 1999, the 150-feet long by 2.5-feet wide PRB containing zero-valent iron (Fe^0) was constructed approximately 125-feet downgradient of the Site 73 source area. The PRB was constructed to a depth of approximately 34-feet bgs (overburden/weathered bedrock interface).

Construction of the PRB was completed in August 1999, and a one-year performance-monitoring program was performed to evaluate the PRB. Groundwater potentiometric and analytical data were collected in accordance with the *Site 73 Permeable Reactive Wall Technology Demonstration, Performance Monitoring Plan* (Bechtel, 1999c). These data were presented and evaluated on a preliminary basis in a series of quarterly reports, and a comprehensive evaluation of the data was presented in the *Site 73 Permeable Reactive Wall Technology Demonstration, Technology Evaluation Report* (Bechtel, 2001b). At the same time, characterization of the downgradient plume at Site 73 was investigated and reported in the *Technical Memorandum for the Investigation of the Downgradient Portion of the Site 73 Chlorinated Solvent Plume* (Bechtel, 2000b).

The *Site 73 Permeable Reactive Wall Technology Demonstration, Technology Evaluation Report* (Bechtel, 2001b) presented a comprehensive summary and evaluation of performance monitoring data collected during the one-year demonstration period. The performance program determined that the PRB was successfully capturing and treating 100% of the contaminated groundwater plume within the overburden. However, it was determined that a portion of the plume was reaching the overburden/bedrock interface upgradient of the PRB, and a small portion of the total plume underflows the PRB. It was estimated in the Technology Evaluation that this portion of the contaminant plume that is underflowing the PRB represents less than 2% of the total contaminant mass within the plume. Consequently, it was concluded that the PRB was performing as designed and the Air Force prepared and submitted a *Site 73 Draft Long-Term Monitoring Plan (LTMP)* (Bechtel, 2001c).

Draft versions of the Site 73 Long-Term Monitoring Plans were submitted in 2001 (Bechtel, 2001c) and 2002 (MWH, 2002b). The EPA Region 1 stated in comments on the 2001 LTMP that additional assessment to better understand the portion of the VOC contaminant plume passing underneath the PRB was required. These comments noted the importance of determining whether high concentration areas immediately downgradient of the PRB were the result of portions of the contaminant plume underflowing the PRB or were the result of original plume contamination that had yet to flow to the downgradient monitoring points.

The Air Force continued to collect performance monitoring data during 2001 and 2002 that were reported in the *Site 73 2001 Status Report* (MWH, 2002a) and the *Site 73 2002 Status Report* (MWH, 2003a). The performance monitoring included:

- Collection of analytical samples for VOCs, intrinsic remediation and field parameters annually from 41 wells;

- Collection of water elevation data semi-annually (spring/fall) from 56 monitoring points;
- Collection of continuous water elevation data at eight monitoring points adjacent to and within the PRB; and,
- Annual reporting of data, interpretation and recommendations.

Based upon this performance data the Air Force concluded that the PRB is effectively capturing and reducing chlorinated VOCs in groundwater in the source area and is fostering the reduction of chlorinated VOCs in the downgradient plume area. Recent monitoring data indicate significant reductions of chlorinated VOCs in groundwater downgradient of the PRB. Figure 7.11-4 show the limited extent of chlorinated VOCs in groundwater downgradient of the PRB above the RGs detected during the most recent monitoring activities. Figures 7.11-5, 7.11-6 and 7.11-7 show the current and historical chlorinated VOC concentrations in monitoring wells immediately upgradient and downgradient of the PRB for each of the hydrogeologic zones. As shown in the figures, the PRB has had a significant impact on the groundwater quality downgradient of the PRB since its installation noted by the decrease of VOCs downgradient.

The Air Force recommended in the *Site 73 2002 Status Report* (MWH, 2003a) that a demonstration of remedial actions operating properly and successfully to allow for transfer of deed of the Site 73 portion of Zone 3 and a new Long-Term Monitoring Plan be prepared and submitted in 2003. The *Draft Demonstration of Remedial Actions Operating Properly and Successfully (OPS)* (MWH, 2003b) was submitted for review in June 2003 and the *Draft Site 73 LTMP* (MWH, 2004c) was submitted for review in January 2004.

When it was determined that the *OPS Demonstration* and the *LTMP* would not be finalized in 2003, the Air Force submitted the *Fall 2003 Site 73 Permeable Reactive Wall Performance Monitoring Fieldwork Notification* (MWH, 2003c) in August 2003 to propose additional performance monitoring (as described above) during the review period of *the OPS Demonstration* and the preparation period of the *LTMP*. The analysis of this performance data is included in this *Site 73 2003 Status Report* (MWH,2004b). Concurrent to these site specific regulatory activities, the *Zone 3 ROD Amendment* (MWH, 2003d), was finalized in

December 2003. The *Zone 3 ROD Amendment* included formal documentation of the Site 73 remedy.

The *OPS Demonstration* was finalized in March 2004 (MWH 2004a) and the *LTMP* was finalized in April 2004 (MWH, 2004c).

LUC/ICs are in place for Zone 3, including Site 73 (part of the Zone 3 Excepted Subparcel). The Air Force has retained rights under the 55-year long-term lease with the PDA on the property, which includes LUC/IC measures. These have been implemented, including a GMZ prohibiting use of groundwater, a URZ prohibiting both residential use and establishment of child care facilities, playgrounds or elementary/secondary schools. The Zone 3 GMZ as an ASN requiring concurrence from the Air Force for any development within the GMZ and specifically prohibits any activity that could disturb the ongoing remedy (PRB). The ongoing use of the property conforms with the restrictions of the URZ, and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.11.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999) recommended the performance of a technology demonstration, performance monitoring, and discussions among the EPA, NDHES, and Air Force to determine the best approach for meeting CERCLA requirements at Site 73.

As is described in Section 7.11.2.3 and 7.11.2.4 above, the final remedy for Site 73 (PRB) was selected and implemented. Selection of the remedy was documented in the *Zone 3 ROD Amendment* (MWH, 2003d). In April 2004, the USAF received concurrence from EPA on the *Demonstration of Remedial Actions Operating Properly and Successfully, Site 73, former Pease Air Force Base, Portsmouth, New Hampshire* (MWH, 2004a).

Selection of the remedy, and performance of the remedy were documented in the following reports:

- *Site 73 Permeable Reactive Wall Technology Demonstration Construction Report, Volume I—Text and Appendix A (Performance Monitoring Plan).* Bechtel, 1999c (October).

- *Technical Memorandum for Supplemental Sampling at Site 73.* Bechtel, 2000a (March).

- *Technical Memorandum for the Investigation of the Downgradient Portion of the Site 73 Chlorinated Solvent.* Bechtel, 2000b (June).

- *Site 73 Permeable Reactive Wall Technology Demonstration, Technology Evaluation Report.* Bechtel, 2001b (January).

- *Site 73 2001 Status Report.* MWH, 2002a (February).

- *Site 73 2002 Status Report.* MWH, 2003a (February).

- *Zone 3 Record of Decision Amendment.* MWH, 2003d (December).

- *Demonstration of Remedial Actions Operating Properly and Successfully, Site 73.* MWH, 2004a (March).

7.11.4 TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001).

7.11.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of documents, ARARs and the results of annual monitoring indicate that the remedy is functioning as intended. Long-term monitoring data indicate that the PRB is successfully capturing and remediating a substantial portion of the contaminant plume within the overburden, thus allowing for the downgradient plume to attenuate by naturally occurring conditions. The PRB is allowing for groundwater quality, downgradient of the PRB, to progress towards the attainment of the site-specific RGs, and prevents the migration of contaminants offsite to downgradient groundwater discharge areas. The most recent sampling data from Site 73 indicate that chlorinated VOCs were detected at only three monitoring locations in the downgradient plume area and at concentrations only slightly above (same order of magnitude) the Site 73 RGs. LUC/IC are being maintained and monitored to prevent potentially unacceptable human exposure to site contaminants in groundwater.

7.11.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: Groundwater restoration goals for Site 73 were established in the *Zone 3 ROD Amendment* (MWH, 2003d). There have been no changes in standards.

Changes in Exposure Pathways: There have been no changes in physical site conditions, land use, or exposure pathways that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in toxicity or other contaminant characteristics.

Changes in Risk Assessment Methods: There have been no significant changes in risk assessment procedures.

Expected Progress Toward Meeting RAOs: Implementation of the remedy is expected to meet RAOs, based on observed decreasing contaminant concentration trends downgradient of the PRB.

7.11.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No information has come to light that would call into question the protectiveness of the remedy.

7.11.4.4 Technical Assessment Summary

As described above, the remedy at Site 73 is functioning as intended by successfully capturing and remediating a substantial portion of the contaminant plume within the overburden, thus supporting natural attenuation of the downgradient plume. Additionally, LUC/IC are in place and performing as expected. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. The remedy is currently progressing toward achievement of RAOs, and no other information has come to light that would call into question the protectiveness of the remedy.

7.11.5 ISSUES

No issues were identified for Site 73.

7.11.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine long-term monitoring should continue. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess PRB performance and optimize long-term monitoring activities.

7.11.7 PROTECTIVENESS STATEMENT

The remedial action at Site 73 (installation of the PRB, establishment of the Zone 3 GMZ with long-term monitoring, and institutional controls on the property) is protective of human health and the environment, and will remain so in the future as groundwater RGs are achieved.

7.11.8 REFERENCES

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1998. *Site 73 Conceptual Design Report for the Zero-Valent Iron Permeable Reactive Wall Technology Demonstration.* (April)

Bechtel, 1999a. *Technical Memorandum for the Permeable Reactive Wall Siting Study.* (March)

Bechtel, 1999b. *Five-Year Review Report.* (September)

Bechtel 1999c. *Site 73 Permeable Reactive Wall Technology Demonstration Construction Report, Volume I—Text and Appendix A (Performance Monitoring Plan.* (October)

Bechtel, 2000a. *Technical Memorandum for Supplemental Sampling at Site 73.* (March)

Bechtel, 2000b. *Technical Memorandum for the Investigation of the Downgradient Portion of the Site 73 Chlorinated Solvent Plume.* (July)

Bechtel, 2001a. *Technical Memorandum for Groundwater Flowmeter Measurement Results.* (January)

Bechtel, 2001b. *Site 73 Permeable Reactive Wall Technology Demonstration, Technology Evaluation Report.* (January)

Bechtel, 2001c. *Draft Site 73 Long-term Monitoring Plan.* (March)

EPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007.

Johnson, 1996. *Site 73 Supplemental Groundwater Quality Profiling Report.*(October)

Johnson, 1997. *Supplemental Groundwater Profiling – Phase II—at Pease Air Force Base Site 73.* (January)

MWH, 2002a. *Site 73 2001 Status Report.* (February)

MWH, 2002b. Revised Draft Site 73 Long-Term Monitoring Plan. (February)

MWH, 2003a. *Site 73 2002 Status Report.* (February)

MWH, 2003b. *Draft Demonstration of Remedial Actions Operating Properly and Successfully, Site 73.* (June)

MWH, 2003c. *Fall 2003 Site 73 Performance Monitoring Fieldwork Notification.* (August)

MWH, 2003d. *Zone 3 Record of Decision Amendment.* (December)

MWH, 2004a. *Demonstration of Remedial Actions Operating Properly and Successfully.* (March)

MWH, 2004b. *Site 73 2003 Status Report.* (April)

MWH, 2004c. *Site 73 Long-Term Monitoring Plan.* (April)

Weston, 1994. *Zone 3 Remedial Investigation Report, Addendum 2, Site 73 Site Investigation.* (May)

Weston, 1995. *Zone 3 Record of Decision.* (December)

Weston, 1996. *Site 73 Remedial Investigation Report/Feasibility Study. (September)*

7.12 ZONE 3, SITE 49

7.12.1 BACKGROUND

7.12.1.1 Site Description

Site 49 is approximately 5 acres in size and is located at the intersection of Pease Boulevard and International Drive. Figure 7.12-1 shows the location of Site 49. Building # 22 has been demolished and the site has been redeveloped with a privately owned office building. Construction of an additional commercial office building and parking garage was completed on the parcel of land located to the west of Site 49 in 2002, including the construction of a stormwater retention basin located approximately 300 feet to the southwest of the Site (MWH, 2003a). Figure 7.12-2 shows the location of specific site features at Site 49.

In general, the geology at Site 49 consists of sandy/silt backfill material and a native gravelly sand overburden overlying fractured phyllite bedrock. The site subsurface is comprised of three interconnected hydrogeologic zones, whose depth and thickness vary throughout the site. These are, in order of increasing depth:

Zone 1: Overburden – The overburden consists mainly of fill material, silty sand, and glacial till comprised of a poorly sorted mixture of gravel, sand, and silt from ground surface to a varying depth of 15 to 20 feet bgs in the area immediately downgradient of former Building #22.

Zone 2: Shallow Bedrock - A highly fractured zone of weathered phyllite bedrock underlies the overburden and has a thickness range of 1 to 5 feet in the area immediately downgradient of former Building #22. Fractured bedrock is encountered at depths ranging from approximately 14 to 20 feet bgs across the site.

Zone 3: Deep Bedrock – Site investigations have indicated that bedrock becomes increasingly competent with depth. Competent bedrock has been generally encountered at depths ranging from 16 to 24 feet bgs in the area immediately downgradient of the former Building #22 and at depths ranging from 24 to 32 feet bgs in the downgradient plume.

Groundwater level measurements collected during investigations and monitoring activities indicate that groundwater is generally encountered at a depth of 4 to 8 feet bgs across the site. Potentiometric surface mapping has indicated that groundwater horizontal flow is generally in an easterly direction across the site.

Horizontal groundwater seepage velocity for the overburden (Zone 1) is calculated as ranging from 1.0 ft/day to 2.4×10^{-4} ft/day. Horizontal groundwater seepage velocity for the shallow bedrock (Zone 2) is calculated as ranging from 0.26 ft/day to 1.1×10^{-2} ft/day. These ranges of values were obtained by using the reported K values, an average hydraulic gradient of 0.03 and a porosity value of 0.3 for overburden soils and 0.2 for shallow bedrock.

Air Force records for Site 49 indicate that TCE and PCE were used as solvents and degreasers at Building #22. TCE was in common use at Pease AFB from 1956 until 1973 and was reported to have been used at Building #22 until 1978. Cleaning and degreasing operations were conducted in the vicinity of the south wing area of Building # 22, with discharges to the environment apparently occurring in the form of spills or on-site disposal associated with the normal daily operations. These discharges resulted in releases of TCE and PCE to the soils and groundwater in the vicinity of the building. The resulting VOC plume is being treated with a zero-valent iron permeable reactive barrier (PRB).

Figure 7.12-3 shows the area of historic groundwater contamination, the wells in the long-term monitoring network and the predominant groundwater flow direction.

7.12.1.2 Initial Response

In 1997, approximately 800 cubic yards of contaminated soil were removed. In 1998, a crushed drum and approximately 3 cubic yards of impacted soil were removed east of former Building #22. Post-removal sampling concluded that the majority of the impacted soils were removed (Bechtel, 1999).

7.12.1.3 Basis for Taking Action

The *Zone 3 Record of Decision (ROD)* (Weston, 1995) did not include Site 49. Previous investigations of Site 49 by R.W. Gillespie & Associates (1997), Bechtel Environmental

(Bechtel) (1997), and TN & Associates (1999) identified chlorinated organics in both soils and groundwater. The primary contaminants include TCE, PCE, and their associated degradation products. The source of the contamination is presumed to be the former maintenance activities in the vicinity of the garage of former Building #22.

In November and December of 1999, a supplemental site characterization was conducted by Versar, (Versar, 2000a) to optimize the location and geometry of the proposed remedial action (a PRB containing zero-valent iron [Fe^{0}]). Results of soil samples collected from the overburden soil indicated that no VOCs compounds exceeded the New Hampshire S-3 Soil Standards. Results of overburden groundwater samples identified 1,1-dichloroethene (DCE), cis-1,2-DCE, PCE, TCE, and vinyl chloride as contaminants of concern, which exceeded the applicable New Hampshire Ambient Groundwater Quality Standards (AGQS) (NHDES, 1999). The major contaminant detected was TCE with a maximum value of 491 μg/L, which exceeds the AGQS of 5 μg/L. Bedrock groundwater sample results identified 1,1-dichloroethane (DCA), 1,1-DCE, cis-1,2-DCE, PCE, TCE, and vinyl chloride as contaminants of concern at concentrations above their respective AGQS. TCE was the major contaminant detected with a maximum value of 2,440 μg/L, exceeding the AGQS of 5 μg/L.

In June 2000 the Air Force issued *The Site 49 Remedial Action Decision Consensus Statement* (AFBCA, 2000) documenting the remedial action decision for Site 49, which included the installation of an in-situ remediation system using zero-valent iron in a PRB to restore contaminated groundwater downgradient of the PRB. This conceptual remediation model works on the basis of groundwater flowing through the reactive barrier under natural gradient and degrading the chlorinated VOCs through the process of reductive dehalogenation.

7.12.2 REMEDIAL/REMOVAL ACTIONS

7.12.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Site 49 - Action Memorandum for a Non-Time Critical Removal Action (2000):

On February 29, 2000, the Air Force issued an *Action Memorandum for a Non-Time Critical Removal Action* for Site 49. This document outlined the selection of a permeable reactive barrier as the removal action to be implemented at the Site to address contaminated groundwater (AFBCA, 2000).

Zone 3 Record of Decision Amendment (2003):

The *Zone 3 ROD Amendment* (MWH, 2003b) formally documented the response action implemented at Site 49 to be consistent with CERCLA of 1980 and NCP. The response action activities documented in the ROD Amendment included:

- In-situ groundwater treatment with a zero valent iron PRB;
- Monitored natural attenuation of the groundwater contaminant plume down-gradient of the PRB;
- Implementation of a long-term performance monitoring plan; and
- Establishment of a GMZ in accordance with New Hampshire regulations.

7.12.2.2 Remedial Action Objectives

The *Zone 3 ROD Amendment* (MWH, 2003b) identified the following general Zone 3 RAOs relevant to Site 49:

- Protect human receptors from ingestion of, or direct contact with, contaminated groundwater that may present an unacceptable health risk;
- Comply with chemical-specific ARARs; and
- Prevent discharge of contaminated groundwater to surface water bodies where such discharges may cause unacceptable risks to human health and the environment (MWH, 2003b).

RGs for groundwater at Site 49, as presented in the *Zone 3 ROD Amendment* (MWH, 2003b), are listed in Table 7.12-1.

7.12.2.3 Remedy Description

The response action activities documented in the ROD Amendment included:

- In-situ groundwater treatment with a zero valent iron PRB;
- Monitored natural attenuation of the groundwater contaminant plume down-gradient of the PRB;
- Implementation of a long-term performance monitoring plan; and
- Establishment of a GMZ in accordance with New Hampshire regulations.

In addition, the *Zone 3 ROD Amendment* (MWH, 2003b) noted the implementation of ICs as a component of the Site 49 remedy. ICs are the non-technical non-engineering actions, which support or complement the implementation of cleanup actions required by the remedy. Implementation, monitoring, and enforcement of the selected ICs are used to ensure protection of human health and the environment at property encompassed by Site 49. The goals of the ICs are designed to be protective of human health and the environment and include:

- Prevent exposure to contaminated soil;
- Prevent exposure to contaminated groundwater;
- Protect the integrity of the Site 49 and Site 73 PRBs, groundwater treatment systems, and monitoring well networks.

Specific components of the ICs include deed restrictions, engineering controls, lease restrictions, notice of the deeded transfer of property, monitoring and enforcement of the ICs.

7.12.2.4 Remedy Implementation

In June-July of 2000, Versar, installed the PRB at Site 49 with both a shallow and deep component. Figure 7.12-2 shows the location of these components of the PRBs. The PRB component installations are summarized below and detailed in the *Shallow and Deep PRB Construction Installation Report* (Versar, 2000b).

The shallow PRB was placed in the overburden at a location downgradient of the highest VOC groundwater concentrations. Upon completion, the shallow PRB measured approximately 150 feet in length, and had an average depth and thickness of 15 feet and 2.5 feet, respectively. The shallow PRB component was designed as a continuous wall extending from the groundwater surface (approximately 5 feet bgs) to the top of shallow bedrock (average depth 15 feet bgs). The wall thickness was to be determined by the construction method selected, and was to be equivalent to 0.75 feet of 100 percent iron as calculated for the specific site conditions by Environmental Technologies, Inc. (ETI), the proprietor of this patent-pending remedial technology (Versar, 2000b). The wall was installed approximately 200 feet downgradient of the suspected source area and along the western edge of the present office building.

The deep PRB consists of 40 shallow bedrock borings, 6 inches in diameter, spaced at 5-foot intervals and backfilled with 100 percent zero-valent iron within the zone of interest, approximately 15 to 30 feet bgs. The deep PRB portion of the wall was placed parallel to the shallow portion and at a 75-degree angle to the groundwater flow direction in order to maintain optimal plume/PRB contact area.

Performance and long-term monitoring groundwater monitoring is ongoing at Site 49 as part of the remedial action for the Site. A total of sixteen monitoring wells and twelve piezometers were installed in August and September 2000 to augment the set of existing on-site wells. The piezometers were placed in clusters around the PRB to evaluate its performance. Fourteen monitoring wells were placed downgradient of the PRB to expand coverage of the existing monitoring well network, both horizontally and vertically. The remaining two monitoring wells were placed upgradient of the PRB to determine the quality of groundwater entering the PRB.

The USAF submitted the *Site 49 Groundwater Management Permit Application Substantive Requirements Demonstration* (MWH, 2002a) in February 2002 and received written approval of the demonstration from NHDES in May 2002. The approval of the *Substantive Requirements Demonstration* established a GMZ for Site 49 as described in Env-Wm 1403 (Figure 7.12-2).

The *Zone 3 ROD Amendment* (MWH, 2003b) was finalized in December 2003 and included Site 49 to formally document the implemented remedy, consistent with the CERCLA and the NCP. The *Zone 3 ROD Amendment* (MWH, 2003b) established site-specific groundwater restoration goals for Site 49. The Site 49 RGs are listed in Table 7.12-1.

Performance monitoring at Site 49 is currently performed in accordance with the *Site 49 Performance and Long-Term Monitoring, Sampling and Analysis Plan Revision 1* (MWH, 2002c). Performance and long-term monitoring data to date indicate that groundwater contaminant concentrations and plume geometry at Site 49 are currently relatively stable across the site and only minor concentration decreases are observed downgradient of the PRB. This consistency in concentrations has been attributed to several factors, including:

- A relatively low groundwater seepage velocity found on site, caused by the aquifer's relatively low hydraulic conductivity;
- Installation of the PRB within the existing contaminant plume; and
- Lack of significant recharge both upgradient and downgradient of the PRB due to the buildings and associated parking lots.
- The possibility that the PRB is receiving and treating groundwater from both upgradient and downgradient of the PRB and is transmitting treated groundwater to the aquifer at the southern end of the PRB.

To date, groundwater containing VOCs above the Site 49 groundwater RGs has not migrated outside the Site 49 GMZ boundary. LUC/ICs are in place for Zone 3, including the Site 49 excepted subparcel. The Air Force has retained rights under the 55-year long-term lease on the property which includes establishment of LUC/IC measures. These have been implemented, including a GMZ prohibiting use of groundwater, a URZ prohibiting both residential use and establishment of child care facilities, playgrounds or elementary/secondary schools. The Site 49 GMZ is an ASN requiring concurrence from the Air Force for any development within the GMZ and specifically prohibits any activity that could disturb ongoing remedies. The ongoing use of the property conforms with the restrictions of the URZ, and this is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.12.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999) recommended moving forward with an EE/CA and removal action and final remedy selection at Site 49.

As is described in Section 7.12.2.3 and 7.12.2.4 above, the final remedy for Site 49 (PRB) was selected and implemented. Selection and construction of the remedy were documented in the following reports:

- *Technical Memorandum, Supplemental Site Characterization.* Versar, Inc. 2000a. (February)
- *Shallow and Deep PRB Construction Installation Report.* Site 49 Remedial Action. Versar, Inc. 2000b. (February)
- *Site 49 Remedial Action Decision, Consensus Statement.* AFBCA. June 16, 2000. (June)
- *Zone 3 Record of Decision Amendment.* MWH, 2003b (December)

Performance of the remedy after implementation was documented in the following:

- *Site 49 Remedial Action - Groundwater Sampling and Analysis Summary Report. (Volume 1-4).* Versar, Inc. 2001. (January)
- *Site 49 2001 Annual Report.* MWH, 2002b. (May)
- *Site 49 Groundwater Management Permit Application Substantive Requirements Demonstration.* MWH, 2002a. (May)
- *Site 49 2002 Annual Report.* MWH, 2003a. (April)

Performance monitoring requirements for Site 49 were documented in the following:

- *Site 49 Performance and Long-Term Monitoring Sampling and Analysis Plan.* Versar, Inc. 2000c. (November)
- *Site 49 Performance and Long-Term Monitoring, Sampling and Analysis Plan Revision 1.* MWH, 2002c. (July)

7.12.4 TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001).

7.12.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of documents, ARARs and the results of performance monitoring indicate that the remedy is functioning as intended. Initial soil removal efforts resulted in source reduction. The PRB is passively capturing and facilitating reductive dechlorination of contaminated groundwater. However, further investigation of groundwater flow characteristics in the immediate vicinity of the PRB is required to provide a complete understanding of PRB performance. Long-term monitoring data indicate that contaminant concentrations are relatively stable across much of the site, groundwater containing concentrations of VOCs above the Site 49 RGs has not migrated outside of the established GMZ, and the most recent sampling data from Site 49 indicate reductions of chlorinated VOCs in several downgradient plume monitoring points. LUC/ICs are maintained and monitored to prevent potentially unacceptable human exposure to site contaminants in groundwater and to prevent land uses that are prohibited under the long-term lease.

7.12.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: Groundwater restoration goals for Site 49 were established in the *Zone 3 ROD Amendment* (MWH, 2003b). There have been no changes in standards.

Changes in Exposure Pathways: Field investigations that supported the development of the November 1999 Site 49 EE/CA included the collection of soil gas samples to evaluate the potential intrusion of VOC vapors into the commercial office building overlying the groundwater plume. Four soil gas samples were collected immediately next to the office building foundation. Groundwater contaminant concentrations for five VOCs exceeded NHDES's Contaminated Sites Risk Characterization and Management Policy (RCMP) GW-2 standards. These standards are intended to provide guidelines on when it may be appropriate to examine the indoor air exposure pathway. None of the five Site 49 VOCs were detected in the soil gas samples that were collected. Since completion of the EE/CA and subsequent construction of the PRB, additional guidance, including EPA's *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (November 2002), has been developed to aid in evaluating the potential for human exposure from this pathway. The Air Force will consider this and any other appropriate guidance to determine if the vapor intrusion pathway at Site 49 requires additional analysis. There have been no changes in physical site conditions, land use, or exposure pathways that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in toxicity or other contaminant characteristics.

Changes in Risk Assessment Methods: There have been no significant changes in risk assessment procedures.

Expected Progress Toward Meeting RAOs: Implementation of the remedy is currently meeting the RAOs of preventing exposure to contaminated groundwater, and preventing the discharge of contaminated groundwater to surface water bodies. A longer than anticipated timeframe may be needed to meet groundwater ARARs, because of site-specific factors (e.g., low hydaulic conductivities, low gradient, limited recharge). However, the remedy is still expected to meet groundwater restoration goals in the future.

7.12.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No information has come to light that would call into question the protectiveness of the remedy.

7.12.4.4 Technical Assessment Summary

As described above, the remedy at Site 49 is functioning as intended by successfully capturing and remediating a portion of the contaminant plume within the overburden. Additionally, LUC/ICs are in place and performing as expected. No changes in exposure pathways , toxicity or other contaminant characteristics are affecting the protectiveness of the remedy. The potential vapor intrusion pathway has not been examined since 1999 and may require analysis if more specific guidance becomes available for commercial buildings. While declining COC trends have yet to develop across all portions of the downgradient plume, the remedy is currently progressing toward achievement of RGs. No information has come to light that could call into question the protectiveness of the remedy.

7.12.5 ISSUES

Additional investigation of the hydraulic characteristics in the immediate vicinity of the PRB should be performed, to allow better understanding of groundwater flow near and through the PRB and support assessment of remedy performance.

7.12.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine long-term monitoring should continue. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess PRB performance and optimize long-term monitoring activities. Investigation should be performed to confirm the hydraulic characteristics of the PRB and surrounding aquifer. Additionally, investigation of the possible vapor intrusion pathway should be undertaken when EPA guidance more applicable to commercial buildings is available.

7.12.7 PROTECTIVENESS STATEMENT

The remedial action at Site 49 (installation of the PRB, establishment of the GMZ with long-term monitoring, and institutional controls on the property) is currently protective of human health and the environment, and will remain so in the future as groundwater RGs are achieved.

7.12.8 REFERENCES

AFBCA, 2000. *Site 49 Remedial Action Decision, Consensus Statement.* June 16, 2000. (June)

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1997. *Contamination Assessment Report*, Site 49 Communications Building, Number 22. (December)

Bechtel, 1999. *Five-Year Review Report*, Pease Air Force Base. (September)

EPA, 2002. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (November)

MWH, 2002a. *Site 49 Groundwater Management Permit Application Substantive Requirements Demonstration.* (May)

MWH, 2002b. *Site 49 2001 Annual Report.* (May)

MWH, 2002c. *Site 49 Performance and Long-Term Monitoring, Sampling and Analysis Plan Revision 1.* (July)

MWH, 2003a. *Site 49 2002 Annual Report.* (April)

MWH, 2003b. *Zone 3 Record of Decision Amendment.* (December)

R.W. Gillespie & Associates, Inc., 1997. *Phase I and II Environmental Assessment Report*, Site 49. (June)

TN & Associates, Inc., 1999. *Engineering Evaluation/Cost Analysis Report, Site 49 Communications Building No. 22.* (July)

Versar, Inc., 2000a. *Technical Memorandum, Supplemental Site Characterization.* (February)

Versar, Inc., 2000b. *Shallow and Deep PRB Construction Installation Report, Site 49 Remedial Action.* (February)

Versar, Inc. 2000c. *Site 49 Performance and Long-Term Monitoring Sampling and Analysis Plan.* (November)

Versar, 2001. *Site 49 Remedial Action - Groundwater Sampling and Analysis Summary Report. (Volume 1-4).* (January)

Weston, 1995. *Zone 3 Record of Decision.* (September)

8.0 CATEGORY 2 SITES, LONG-TERM MONITORING ONLY, SURFACE WATER/SEDIMENT WITH REMEDIAL ACTIONS COMPLETED

8.1 MAP

Category 2 sites addressed in this *Five-Year Review Report* include drainage features associated with Zone 1, Drainage Area A (Pauls Brook), Drainage Area J (Railway Ditch and Flagstone Brook) and Zone 3, Drainage Area F (McIntyre Brook). The locations of these drainage areas are illustrated in Figure 8.1-1.

8.2 DATA SUMMARY TABLE

Table 8.2-1 summarizes information in this *Five-Year Review Report* for sites in Category 2. The columns in this table include the following information:

Site I.D. – The IRP Zone and site identifier used in the first *Five-Year Review Report* (Bechtel, 1999).

Sites Included – A listing of individual IRP sites included under the IRP Zone/site identifier in this *Five-Year Review Report*.

Site Chronology – A chronological listing of major documents associated with remedial actions performed at the sites.

Background – Description of site location and brief history of site activities that may have resulted in the release of hazardous substances to the environment.

Remedial Actions – Description of cleanup actions performed at the site.

Implementation of Recommendations From Last Five-Year Review – Summary of IRP actions performed during the reporting period (1999 – 2004).

Remarks – Primary document(s) governing remedial actions at the site.

8.3 FIVE-YEAR REVIEW OF CATEGORY 2 SITES

Individual subsections are provided to document the Five-Year Review process for each of the sites included in Category 2. These subsections are organized by IRP Zone/site identifier used in the first *Five Year Review Report* (Bechtel, 1999), and include the following:

- Background information: site description, initial responses, and basis for taking action;
- Remedial/removal action description: regulatory actions, RAOs, remedy description, and remedy implementation;
- Implementation of recommendations from last five year review;
- Technical assessment: answers to Questions A, B, and C in the *Comprehensive Five-Year Review Guidance* (EPA, 2001);
- Issues;
- Recommendations and follow-up actions;
- Protectiveness statements; and
- References.

8.4 ZONE 1, PAULS BROOK

8.4.1 BACKGROUND

8.4.1.1 Site Description

Pauls Brook is the primary drainage feature in Drainage Area A and is shown on Figure 8.4-1 (Bechtel 1998a). The drainage collects surface water and sediment from BFSA (Site 13) and a portion of the PCDA (Site 44). Pauls Brook begins west of Arboretum Drive slightly north of Site 13, as an emergent wetland dominated by cattails. Surface water runoff from Site 13 is directed through stormwater drains and empties into Pauls Brook before it crosses under Arboretum Drive. On the eastern side of Arboretum Drive, Pauls Brook enters a second, larger, wetland area (the focus of historical remedial action) located between Arboretum Drive and the Spaulding Turnpike (see Figure 8.4-2). Pauls Brook flows through this wetland area and is carried off base through a culvert beneath the Spaulding Turnpike and eventually discharges to the Piscataqua River.

Pauls Brook is a relatively small stream with a flow velocity of less than 0.5 feet per second (ft./sec.) and the stream bed ranges 0.8 to 3.8 feet wide and 0.1 to 0.3 feet deep (USAF, 1997).

Potential sources of contamination for Pauls Brook included the Paint Can Disposal Area and the Bulk Fuels Storage Area. The Paint Can Disposal Area was reportedly operated over a 30-year period and was used to store and dispose of drums that contained paint and paint residues (Weston, 1993a). An intensive test pit operation, performed in 1992, included removal of potential contaminant sources, including grossly contaminated soil and crushed drums. Soil samples collected during the test pit operations identified minor levels of contamination in a limited number of samples. Contamination consisted primarily of VOCs, including chlorinated solvents and BTEX compounds; SVOCs, comprised of low concentrations of PAHs and benzoic acid; DDT related pesticides and the herbicide 2,4,5-TP (Silvex); and low concentrations of TPHs. No further remedial actions under the CERCLA were required for Site 44 (Weston, 1995a).

The BFSA (Site 13) was in operation from 1953 to 1994. Prior to base closure, the site served as the main fuel storage area at the base for both the USAF and the New Hampshire Air National Guard. Petroleum product spills were reported to have occurred at the site (Weston, 1993b).

Pesticide compounds have been detected in Pauls Brook throughout the history of monitoring this drainage. Pesticides detected in Paul's Brook may be the result of routine regular use of pesticides in the area or from past operational activities at the former Civil Engineering Department complex.

8.4.1.2 Initial Response

No remedial action was performed at Pauls Brook prior to the finalization of the *Brooks and Ditches ROD* (USAF, 1997).

8.4.1.3 Basis for Taking Action

Although Pauls Brook is located within Zone 1, surface water and sediment remedial actions and sampling were separated from the Zone 1 ROD in order to complete remedial actions at Zone 1 without a delay (USAF, 1997). A RI/FS process was undertaken to address surface water and sediment within Pauls Brook (Weston, 1995b). Both organic and inorganic constituents were detected in surface water within Pauls Brook and organics; inorganics, PAHs, and pesticides were detected in sediment within Pauls Brook. The results of human health and ecological risk assessments performed for the Brooks and Ditches ROD (USAF, 1997) identified organic and inorganic constituents in sediment within Pauls Brook as posing an unacceptable ecological risk and a remedial alternative was identified in the ROD, as described below.

8.4.2 REMEDIAL/REMOVAL ACTIONS

8.4.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Brooks and Ditches Operable Unit Record of Decision (1997):

Remedial action for Pauls Brook was addressed in the *Brooks and Ditches ROD* (USAF, 1997). The chosen alternative for Pauls Brook included the removal and off-site disposal of contaminated sediment from the brook.

8.4.2.2 Remedial Action Objectives

The ROD identified and documented RAOs for Pauls Brook as the protection of ecological receptors from direct contact with, or ingestion of, sediment containing contaminants at concentrations that may present an unacceptable ecological risk.

The cleanup goals established in the Brooks and Ditches ROD for sediment within the Pauls Brook drainage are included in Table 8.4-1. The Brooks and Ditches ROD did not identify cleanup standards for surface water. Surface water data collected during monitoring were compared to New Hampshire Water Quality Criteria for Toxic Substances (WQC) (Env-Ws 1700).

8.4.2.3 Remedy Description

To meet the RAOs described above for Pauls Brook objective, a remedy was selected which included the following components:

- Excavation and removal of sediment exceeding cleanup goals from Pauls Brook;
- Excavated sediment exceeding cleanup goals from Pauls Brook transported off-base for treatment and/or disposal;
- Sediment and erosion control during excavation. Sediment excavations backfilled with clean fill;
- Restoration of wetlands impacted or destroyed by sediment excavation at Pauls Brook;
- Environmental monitoring during remedial operations; and
- Long-term environmental monitoring in Pauls Brook, consisting of sediment and surface water sampling and analysis (USAF, 1997).

8.4.2.4 Remedy Implementation

A remedial action to remove contaminated sediment from Pauls Brook was completed in the fall of 1997. The excavation limits for the removal action were defined in the *McIntyre Brook and Pauls Brook, Zone 3 Excavation and Construction Work Plan Addendum* (Bechtel, 1997). Excavation was conducted in the flooded perimeter of the brook and resulted in the removal of 2,242 tons of sediment (Bechtel, 1998b). Excavation in the cleanup area proceeded until sediment concentrations of arsenic, cadmium, chromium, copper, lead, nickel, zinc, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and total PAHs were below the cleanup goals.

Three permanent surface water and sediment monitoring stations (23-8040, 23-8041, and 23-813), shown on Figure 8.4-2 were established in Pauls Brook for long-term monitoring activities and have been monitored since June of 1991. Currently, long-term monitoring at Pauls Brook is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a) and consists of sediment monitoring for site specific metals only. Surface water monitoring at Pauls Brook ceased in 2003, with EPA and NHDES concurrence.

Long-term monitoring data indicate that site-specific metals in sediment continue to be detected above the cleanup goals at relatively stable concentrations. Metals and pesticide concentrations in surface water are stable or decreasing below the New Hampshire WQC (1999), Env-Ws 1700 (MWH, 2003b). As a result, surface water monitoring was removed from the long-term monitoring program in 2003. Long-term monitoring of pesticides and PAHs in sediment was also discontinued in 2003. Data indicated that detections of these compounds in sediment are decreasing or below the established remedial goals and the remaining detections of these compounds was concluded to be the result of non-site related activities (MWH, 2002). The Air Force received EPA and NHDES concurrence on these monitoring reductions prior to making the changes to the long-term monitoring program at Pauls Brook.

8.4.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedy at Pauls Brook remained protective of human health and the environment. Annual evaluations of surface water and sediment monitoring were recommended to track possible increasing trends in metals concentrations in surface water and sediment and to determine if additional actions were necessary. Annual evaluations were also recommended to identify opportunities to refine long-term monitoring activities.

Annual sampling and analysis have been performed as recommended. Results of the monitoring were reported in:

- *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update*. Bechtel, 2000 (August).
- *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report.* MWH, 2002 (June).
- *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* (MWH, 2003) June.

As is described under Section 8.4.2.4 above, surface water monitoring has been discontinued, and sediment monitoring has been reduced in scope based on decreasing trends in concentration and/or achievement of remedial goals. These reductions in long-term monitoring are documented in:

- *Basewide Surface Water and Sediment Long-Term Monitoring Plan - Year 2003 Update*. MWH, 2003 (March).

8.4.4 TECHNICAL ASSESSMENT

8.4.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The remedy at Pauls Brook is functioning as intended by the *Brooks and Ditches ROD* (USAF, 1997). The remedial action to remove contaminated sediment from Pauls Brook was completed during the fall of 1997, with excavation continuing until sediment concentrations of arsenic, cadmium, chromium, copper, lead, nickel, zinc, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and total PAHs were below cleanup standards (Bechtel, 1999). Sediment monitoring has been reduced in scope (PAHs and pesticides removed as monitoring parameters) because of trends in concentrations and/or attainment of cleanup goals. Surface water monitoring was discontinued during 2003 because metals and pesticide concentrations were stable and/or decreasing below New Hampshire Water Quality Criteria for Toxic Substances.

8.4.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: Cleanup goals for surface water in Pauls Brook were not established in the *Brooks and Ditches ROD* (USAF, 1997). The New Hampshire WQC (Env-Ws 1700) were used as the basis for comparison with surface water data until surface water monitoring was discontinued in 2003 (with EPA and NHDES concurrence). There have been some minor changes to the sediment screening values used to derive the cleanup goals for metals (arsenic, chromium, copper, and zinc) in sediment at Pauls Brook. These changes do not significantly affect the protectiveness of the remedy.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Ecological risk-based concentrations were used to establish cleanup standards for cadmium, 4,4'-DDD, 4,4'-DDT, and 4,4'-DDE. Unlike human health risk assessments, EPA does not recommend specific toxicity reference doses for constituents in ecological risk assessments. EPA and NHDES have concurred that monitoring for pesticides in Pauls Brook is no longer warranted, because data confirm that the sediment remedy at Pauls Brook was successful.

The cleanup level calculated for cadmium in sediment was based on modeled risk estimates to a short-tailed shrew (Weston, 1995c). The cleanup value included in the *Brooks and Ditches ROD* (USAF, 1997) is conservative and remains protective.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA and EPA Region I guidance. There has not been any significant change in EPA guidance which could result in significant revisions to the cleanup goals. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: Remedial action objectives associated with the sediment removal at Pauls Brook have been attained. Long-term monitoring has documented that surface water concentrations do not pose a threat to human health or the environment.

Concentrations of COCs in sediment continue to be detected above the cleanup goals, but do not appear to show increasing trends. Additionally, concentrations of COCs in sediment do not appear to be directly affecting surface water quality within Pauls Brook.

8.4.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.4.4.4 Technical Assessment Summary

As described above, the remedy at Pauls Brook is functioning as intended. The remedial action objectives associated with the sediment removal at Pauls Brook have been attained. While minor changes exist in sediment screening data used to establish sediment cleanup goals for Pauls Brook, these changes have not impacted the current protectiveness of the remedy. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has been identified that would call into question the protectiveness of the remedy.

8.4.5 ISSUES

The scope of long-term monitoring at Pauls Brook consists of sediment monitoring for site-specific metals, which continue to be detected above cleanup goals. Surface water monitoring has been eliminated from the program as concentrations of COCs in surface water were documented as stable or decreasing. It is not anticipated that concentrations of inorganic constituents in sediment will decrease substantially in the near term. Since surface water concentrations are considered to be stable or decreasing, it is concluded that sediment is not having an adverse effect upon surface water quality.

8.4.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Annual monitoring of sediment within Pauls Brook provides little additional information concerning remedial progress at Pauls Brook, given the stable nature of inorganics in sediment. The sediment cleanup goals for inorganics within Pauls Brook, and the frequency of monitoring, should be reevaluated by the BCT.

8.4.7 PROTECTIVENESS STATEMENT

The remedial action at Pauls Brook (excavation of sediment and long-term monitoring of sediment and surface water) is currently protective of human health and the environment, and is expected to remain so in the future.

8.4.8 REFERENCES

Bechtel, 1997. *McIntyre and Pauls Brook Zone 3 Excavation Construction Work Plan Addendum*. (May)

Bechtel, 1998a. *Pease Air Force Base Basewide Surface Water Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan* (April)

Bechtel, 1998b. *McIntyre Brook and Pauls Brook Remedial Action Report.* (October)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000. *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update.* (August)

EPA, 2001. *Comprehensive Five-Year Review Guidance, EPA 540-R-01-007.*

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report.* (June)

MWH, 2003a. *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update.* (March)

MWH, 2003b. *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* (June)

U. S. Air Force, 1997. *Record of Decision for the Brooks/Ditches Operable Unit.* (September)

Weston, 1993a. *Zone 1 Remedial Investigation Report.* (October)

Weston, 1993b. *Zone 1 Feasibility Study Report.* (December)

Weston, 1995a. *Zone 1 Record of Decision.* (July)

Weston, 1995b. *Brooks/Ditches Remedial Investigation/Feasibility Study Consolidated Report, Pease Air Force Base.* (November)

Weston, 1995c. *Bioaccumulation Risk Assessment for Pauls Brook at Pease Air Force Base, NH.* (December)

8.5 ZONE 3, MCINTYRE BROOK

8.5.1 BACKGROUND

8.5.1.1 Site Description

McIntyre Brook is the primary drainage feature in Drainage Area F and is shown in Figure 8.4-1 (Bechtel, 1998a). This drainage area receives surface water and sediment from the Flightline area (runway and aircraft parking apron), a portion of the Field Maintenance Squadron Equipment Cleaning Area (Site 11), the Leaded Fuel Tank Sludge Disposal Area (Site 10), Burn Area-1 (Site 22), Burn Area-2 (Site 37), Building 410/polychlorinated biphenyls (PCB) spill and UST site (Site 16), and a portion of Building 227 (Site 39). The upstream reach of McIntyre Brook is a stormwater drainage discharge point for the drainage system that collects surface water runoff from most of the Flightline runway and aircraft parking apron.

McIntyre Brook extends southwestward from the Flightline area to Great Bay (approximately 0.8 miles), where the brook discharges. Four weirs regulate flow along the course of McIntyre Brook, with sediment catch basins positioned downstream of each of the weirs. The width of the Brook is fairly consistent along its course (10-15-feet) and maintains a fairly consistent water depth and velocity (0.8 to 1.0-feet and 0.1 to 0.18 ft./sec. respectively) (USAF, 1997). Figure 8.5-1 shows the major features of the McIntyre Brook drainage area and monitoring locations.

The primary contaminant source associated with McIntyre Brook is fuel related compounds from the Flightline area. These compounds include VOCs and PAHs. Runoff collected in the storm drains from the runway and the aircraft parking apron is diverted through an oil/water separator located near the headwater of McIntyre Brook, prior to its discharge into the brook. Additionally, as McIntyre Brook flows off the base, it receives runoff from wetlands, agricultural areas, residential areas, the roadway, and groundwater discharge.

8.5.1.2 Initial Response

No remedial action was performed at McIntyre Brook prior to the finalization of the *Brooks and Ditches ROD* (USAF, 1997).

8.5.1.3 Basis for Taking Action

Although McIntyre Brook is located within Zone 3, surface water and sediment remedial actions and sampling were separated from the Zone 3 ROD in order to complete remedial actions at Zone 3 without a delay (USAF, 1997). A RI/FS process was undertaken to address surface water and sediment within McIntyre Brook (Weston, 1995). Both organic and inorganic constituents were detected in surface water within McIntyre Brook and organics; inorganics, PAHs, and pesticides were detected in sediment within McIntyre Brook. The results of human health and ecological assessments performed for the *Record of Decision for the Brooks/Ditches Operable Unit* (USAF, 1997) (*Brooks and Ditches ROD*) identified organic and inorganic constituents in sediment within McIntyre Brook as posing an unacceptable ecological risk and a remedial alternative was identified in the ROD.

8.5.2 REMEDIAL/REMOVAL ACTIONS

8.5.2.1 Regulatory Actions

The controlling documents that present the selected remedy are described below.

Record of Decision for Brooks/Ditches Operable Unit (1997):

Remedial action for McIntyre Brook was addressed in the *Brooks and Ditches ROD* (USAF, 1997). The chosen alternative for McIntyre Brook included the removal and off-site disposal of contaminated sediment from the brook.

8.5.2.2 Remedial Action Objectives

The ROD identified and documented RAOs for McIntyre Brook as the protection of ecological receptors from direct contact with, or ingestion of, sediment containing contaminants at concentrations that may present an unacceptable ecological risk.

8.5.2.3 Remedy Description

To meet the RAO described above for McIntyre Brook, a remedy was selected which included the following components:

- Excavation and removal of sediment exceeding cleanup goals from McIntyre Brook.
- Transportation and treatment and/or disposal off-base of excavated sediment exceeding cleanup goals from McIntyre Brook.
- Implementation of sediment and erosion controls during excavation. Sediment excavations backfilled with clean fill.
- Environmental monitoring during remedial operations.
- Long-term environmental monitoring in McIntyre Brook, consisting of sediment and surface water sampling and analysis.

The cleanup goals established in the *Brooks and Ditches ROD* for sediment within the McIntyre Brook drainage are included in Table 8.5-1.

8.5.2.4 Remedy Implementation

In 1997, a sediment removal action was performed on McIntyre Brook, covering a majority of the brook from near its headwaters to Newington Road. The excavation limits for the removal action are defined in the *McIntyre Brook and Pauls Brook, Zone 3 Excavation and Construction Work Plan Addendum* (Bechtel, 1997). The remedial action resulted in the removal of 1,951 tons of sediment from McIntyre Brook. Confirmation sampling indicated that lead and zinc concentrations at several sampling stations exceeded the ROD cleanup goals (Bechtel, 1998b). These elevated concentrations were attributed to runoff from McIntyre Road and adjacent agricultural areas.

Following remediation of McIntyre Brook, surface water and sediment sampling commenced in May of 1998 at three permanent monitoring stations (8060, 8077, and 8057), as shown on Figure 8.5-1. Currently, long-term monitoring at McIntyre Brook is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a) and consists of sediment monitoring for site specific metals.

Long-term monitoring data to date have indicated that organic and inorganic concentrations in surface water are below the New Hampshire WQC (1999), Env-Ws 1700 (MWH, 2003b). As a result, surface water monitoring of McIntyre Brook was discontinued following the May 2000 sampling event. Similarly, long-term monitoring data for organic and inorganic constituents in sediment at McIntyre Brook indicated that these compounds are decreasing or below the established remedial goals and the residual detections of these compounds are believed to be the result of non-site related activities (MWH, 2002). As a result, the EPA recommended that the Air Force discontinue long-term monitoring for sediment within McIntyre Brook (EPA, 2003), and monitoring was discontinued in 2003.

8.5.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedy at McIntyre Brook remained protective of human health and the environment. The report recommended evaluation of concentration trends in sediment, and annual evaluation of sediment monitoring data to identify opportunities to refine long-term monitoring activities.

Annual sampling and analysis have been performed as recommended. Results of the monitoring were reported in:

- *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report.* Bechtel, 2001 (February)
- *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report.* MWH, 2002. (June)
- *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* MWH, 2003. (June)

Modifications of long-term monitoring were documented in:

- *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update.* Bechtel, 2000. (August)
- *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update.* MWH, 2003. (March)

As described in Section 8.5.2.4 above, long-term monitoring data indicated that surface water concentrations were less than remedial goals, and surface water monitoring was discontinued during 2000. Based on sediment data, long-term monitoring for sediment within McIntyre Brook was discontinued in 2003.

8.5.4 TECHNICAL ASSESSMENT

8.5.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The chosen remedy at McIntyre Brook is functioning as intended by the *Brooks and Ditches ROD* (USAF, 1997). In 1997, 1,951 tons of sediment were removed from McIntyre Brook from near its headwaters to Newington Road. Both surface water and sediment long-term monitoring have been discontinued, because concentrations of COCs are decreasing or below the established remedial goals and the remaining detections of these compounds are believed to be the result of non-site related activities.

8.5.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards:</u> There have been no changes in standards that affect the protectiveness of the remedy.

<u>Changes in Exposure Pathways:</u> There have been no changes in physical conditions, exposure pathways and land use that would affect the protectiveness of the remedy.

<u>Changes in Toxicity and Other Contaminant Characteristics:</u> Cleanup goals for McIntyre Brook were based on background and TBCs. There have been no changes in toxicity or contaminant characteristics that would affect the protectiveness of the remedy.

<u>Changes in Risk Assessment Methods:</u> The human health risk assessment was conducted following EPA and EPA Region 1 guidance. There has not been any significant change in

EPA guidance. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessments that were conducted are consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: RAOs have been achieved in McIntyre Brook. Both surface water and sediment long-term monitoring have been discontinued, because concentrations of COCs are decreasing or below the established remedial goals and the remaining detections of these compounds are believed to be the result of non-site related activities.

8.5.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.5.4.4 Technical Assessment Summary

As described above, the remedy at McIntyre Brook is functioning as intended. The remedial action objectives associated with the sediment removal at McIntyre Brook have been attained. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has been identified that would call into question the protectiveness of the remedy.

8.5.5 ISSUES

No issues were identified for McIntyre Brook.

8.5.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Long-term monitoring has been discontinued at McIntyre Brook for all constituents and all media. It is recommended that McIntyre Brook be removed from future Five-Year Reviews.

This *Five-Year Review Report* would serve as the final review of remedial activities at McIntyre Brook.

8.5.7 PROTECTIVENESS STATEMENT

The remedial action at McIntyre Brook (excavation of sediment and long-term monitoring of sediment and surface water that has now been terminated) is protective of human health and the environment, and is expected to remain so in the future.

8.5.8 REFERENCES

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, (October)

Bechtel, 1997. *McIntyre and Pauls Brook Zone 3 Excavation Construction Work Plan Addendum.* (May)

Bechtel, 1998a. *Pease Air Force Base Basewide Surface Water Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan.* (April)

Bechtel, 1998b. *McIntyre Brook and Pauls Brook Remedial Action Report.* (October)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000. *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update.* (August)

Bechtel, 2001. *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report.* (February)

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report.* (June)

MWH, 2003a. *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update.* (March)

MWH, 2003b. *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* (June)

U. S. Air Force, 1997. *Record of Decision for the Brooks/Ditches Operable Unit.* (September)

EPA, 2003. *Comments on the 2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report.* (March)

Weston, 1995. *Brooks/Ditches Remedial Investigation/Feasibility Study Consolidated Report.* (November)

8.6 RAILWAY DITCH

8.6.1 BACKGROUND

8.6.1.1 Site Description

The Railway Ditch and Flagstone Brook represent the primary drainage features in Drainage Area J (Figure 8.4-1). This drainage area receives surface water and sediment from Landfill-5 (Site 5), Landfill-4 (Site 4), Landfill-2 (Site 2), the northern portion of the Flightline, a portion of the Paint Can Disposal Area (Site 44), and a small portion of the Bulk Fuels Storage Area (Site 13).

Flagstone Brook is the primary stream draining Zone 1 (Figure 8.4-1). Flagstone Brook originates as two culverts at the northern end of the Delta Taxiway/aircraft parking apron and flows northward forming the western boundary of Landfill 5. Railway Ditch flows northward along the eastern border of Landfill 5, eventually joining Flagstone Brook, approximately 3,000 feet north of Landfill 5. Flagstone Brook eventually drains to Little Bay to the north of Pease. Figure 8.6-1 shows the Flagstone Brook/Railway Ditch drainage area features and monitoring locations.

The Brook is a channelized drainage ditch with relatively uniform steep banks and uniform gradient, and contains a series of weir dams constructed for erosion and flood control. The average stream depth and width is recorded in the *Brooks and Ditches ROD* (USAF, 1997) as approximately 0.75 feet and 9-feet respectively. The substrate for most of the Flagstone Brook is sand, cobble, and gravel: however areas of silt and clay exist. Water velocity is reported as averaging approximately 0.2 ft./sec. (USAF, 1997).

The original Landfill 5 occupied approximately 23 acres (consolidation of the wastes for the remedial action resulted in a capped area of approximately 18.5 acres). Landfill 5 is bordered by Arboretum Drive to the north, the Railway Ditch paralleling an abandoned railway bed to the east, Flagstone Brook to the west, the PCDA to the south, and the BFSA to the southeast.

Landfill 5 reportedly was used between 1964 and 1975 as the primary base landfill, although some disposal occurred as late as 1979. Most of the material placed in the landfill consisted of municipal-type solid wastes generated from on-base housing, barracks, offices, dining facilities, etc. Industrial wastes were also disposed of in the landfill, including an unspecified quantity of waste oils, solvents, paints, paint strippers and thinners, pesticide containers, empty cans and drums, and sludge from the industrial waste treatment and base wastewater treatment facilities.

8.6.1.2 Initial Response

No remedial action was performed at Railway Ditch and Flagstone Brook prior to the finalization of the *Landfill 5 ROD* (Weston, 1993a) and *Zone 1 ROD* (Weston, 1995).

8.6.1.3 Basis for Taking Action

The *IRP Stage 3C Landfill 5 RI Report and Zone 1 RI Report* (Weston, 1992a and Weston, 1993b) were completed in April 1992 and October 1993, respectively. The presence of buried wastes and contamination in soil, groundwater, surface water, and sediment in the areas surrounding the landfill was documented in the *IRP Stage 3C Landfill 5 RI Report*. This information was confirmed in the *Zone 1 RI Report* (Bechtel, 1999).

The RI Reports identified the following:

- Three VOCs whose concentrations exceeded the MCLs were identified in the groundwater: tetrachloroethene, trichloroethene, and benzene. Additionally, concentrations of arsenic, beryllium, chromium, and nickel exceeded MCLs.

- The hydraulic gradients across Landfill 5 indicate that groundwater flows towards Flagstone Brook and the Railway Ditch. These drainage ways also receive surface water from Landfill 5. VOCs were detected in surface water in Flagstone Brook and the Railway Ditch, located west and east of Landfill 5 respectively.

- PAHs and pesticides were detected in sediments in Flagstone Brook and the Railway Ditch. Elevated metals concentrations were detected in the Railway Ditch sediments.

Although Flagstone Brook is located within Zone 1 and surface water and sediment contamination were addressed in the *Landfill 5 and Zone 1 RODs* (Weston, 1993a and

Weston, 1995), assessment of risk to human health and ecological receptors was performed in a separate RI/FS process (Weston, 1995) in order to complete remedial actions within Zone 1 without a delay (USAF, 1997).

8.6.2 REMEDIAL/REMOVAL ACTIONS

8.6.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Landfill 5 Record of Decision (1993) and Zone 1 Record of Decision (1995)

Post-closure maintenance and monitoring activities at Landfill 5 are driven by requirements in the *Landfill 5 ROD* (Weston, 1993a) and *Zone 1 ROD* (Weston, 1995). The Landfill 5 ROD primarily addresses soil, debris, surface water and sediment. The Zone 1 ROD primarily addresses contaminated groundwater associated with Landfill 5. The Landfill 5 and Zone 1 RODs included long-term monitoring of surface water and sediment as specific components of remedial action at Landfill 5.

Brooks and Ditches Operable Unit Record of Decision (1997)

It was concluded during the RI/FS process (Weston, 1995) that the contaminants present in surface water and sediment at Flagstone Brook did not pose an unacceptable risk to human health and ecological receptors and no further action under CERCLA was required. Therefore, the Brooks/Ditches ROD is not one of the governing documents for post-closure care activities at Landfill 5 or Flagstone Brook.

8.6.2.2 Remedial Action Objectives

The following RAOs specific to Flagstone Brook and Railway Ditch were identified in the *Landfill 5 ROD*:

- Prevent or minimize risks to ecological receptors resulting from exposure to contaminated sediment in the Railway Ditch and associated wetlands or to contaminated soil and debris associated with Landfill 5.

- Minimize further migration of contaminants from the Landfill 5 source area into the groundwater or surface water.

The following RAOs specific to Flagstone Brook and Railway Ditch were identified in the *Zone 1 ROD* (Weston, 1995):

- Long-term environmental monitoring in the zone to allow the continued evaluation of the magnitude of contamination, including groundwater, surface water and sediment sampling and analysis

Both the *LF-5 and Zone 1 RODs* (Weston, 1993 and Weston, 1995) listed media-specific cleanup goals. These goals for surface water and sediment are summarized below:

- **Surface water** – Cleanup goals for surface water in the Railway Ditch were presented in the LF-5 ROD. No ROD-specified cleanup goals were issued for Flagstone Brook in either the LF-5 or Zone 1 ROD documents (the Brooks and Ditches ROD did not identify cleanup goals for either stream in Zone 1). The Railway Ditch cleanup goals are presented in Table 8.6-1. All surface water cleanup goals were based on the New Hampshire WQC.

- **Sediment** – The LF-5 ROD identified sediment cleanup goals for the Railway Ditch and Flagstone Brook which are presented in Table 8.6-2. Sediment exceeding these criteria was excavated from the Railway Ditch.

8.6.2.3 Remedy Description

To meet the RAO described above for the Railway Ditch, a remedy was selected which included the following components:

- Excavation of soils from the Railway Ditch exceeding the cleanup goals established in the Landfill 5 ROD.

- Long-term environmental monitoring in the zone to allow the continued evaluation of the magnitude of contamination, including groundwater, surface water and sediment sampling and analysis.

8.6.2.4 Remedy Implementation

IT Corporation (IT) was contracted by AFCEE to excavate and relocate landfill debris, soils, and sediments from LF-2, LF-4, and LF-5 and the adjacent Railway Ditch to LF-5 between December 1993 and June 1995. Additionally, IT constructed a lined sedimentation basin to receive groundwater, site runoff, and water pumped from the excavation. Relocated waste was consolidated by IT above the predicted seasonal high groundwater level. An intermediate cap was constructed to cover debris as a precursor to Phase II cap construction performed by Bechtel. A description of this work is presented in the *Excavation and Relocation of Waste, Soil, and Sediments, Landfills 2, 4, and 5* (IT, 1995).

During a second phase of the Landfill 5 remedial action, Bechtel consolidated additional debris and waste soils from LF-6, the UST Flightline area, Site 34, and Site 72 into LF-5. Following consolidation, Bechtel prepared the subgrade and capped LF-5 with a composite-barrier-type final cover system to minimize water infiltration and prevent contact between landfill debris and either human or ecological receptors. After completion of capping, piezometers, landfill gas monitoring probes and vents, and survey monuments were installed as specified in the design. This work was completed between May 1995 and July 1996. The second phase of the remedial action is documented in the *Landfill 5 Remedial Action Report* (Bechtel, 1996).

Prior to 2001, post-closure surface water monitoring was conducted at 11 stations: six in Railway Ditch and five in Flagstone Brook. The *Basewide Surface Water, Sediment and Fish Tissue Long-Term Monitoring Plan – Year 2000 Update* (Bechtel, 2000) reduced this number to six stations, three in Flagstone Brook (stations 26-8031, 26-8182W and 26-821A) and three in Railway Ditch (26-8119, 26-8073 and 26-827). Currently, long-term monitoring of surface water at Drainage Area J is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a) and the existing *Landfill 5 Post-Closure Maintenance and Monitoring Plan (PCMMP)* (Bechtel, 2001a). Sampling locations are shown in Figure 8.6-1. The *LTMP – Year 2003 Update* and the *PCMMP* call for a combination of biennial analyses for VOCs and annual analysis of target metals (aluminum, arsenic, cadmium, copper, iron, lead, mercury, nickel, thallium, and zinc) in surface water of both Flagstone Brook and Railway Ditch.

Long term monitoring data from Drainage Area J indicate that organic contaminants continue to be detected in surface water samples collected from Flagstone Brook and Railway Ditch. However, no cleanup goals were established for VOCs in Flagstone Brook and Railway

Ditch. Data also indicate that metal contaminants continue to sporadically be detected above the ROD specified cleanup goals for surface water in Flagstone Brook and Railway Ditch. These metals exceedances are likely the result of enhanced turbidity caused by rainfall events preceding sampling activities.

Currently, long-term monitoring of sediment within Drainage Area J is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a) and consists of sediment monitoring for site specific metals from Flagstone Brook. Lead is the only site-specific metal that has been detected above cleanup goals at the current Flagstone Brook monitoring locations. Current long-term monitoring data indicate that lead exceeds the cleanup goal for sediment at sample location 26-8031 only.

Sediment within Flagstone Brook has been historically monitored for select pesticides as well. However, the Air Force recommended in the *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report* (MWH, 2002) to discontinue analysis for pesticides in sediment at Flagstone Brook after the 2002 sampling event. This recommendation was based upon the assertion that pesticides were applied in accordance with manufacturer's and Air Force's guidelines and concentrations do not represent evidence of a CERCLA release. The Air Force received EPA and NHDES concurrence on these reductions to long-term monitoring.

8.6.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedy at LF-5 remained protective of human health and the environment. Recommendations in the Five-Year Review Report included continued annual evaluation of environmental monitoring data and assessment of opportunities to refine monitoring activities. Annual long-term monitoring has been performed, and monitoring results for surface water and sediment associated with the Railway Ditch and Flagstone Brook have been reported in:

- *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report.* Bechtel, 2001b (February)

- *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report*. MWH, 2002. (June)

- *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report*. MWH, 2003. (June)

Modifications to the long-term monitoring program for Railway Ditch and Flagstone Brook were included in:

- *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update*. Bechtel, 2000. (August)

- *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update*. MWH, 2003. (March)

As is described under Section 8.6.2.4 above, the scope of surface water and sediment monitoring has been reduced to focus monitoring activities upon remaining contaminants that may be related to Landfill 5 activities.

8.6.4 TECHNICAL ASSESSMENT

8.6.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The chosen remedy at Railway Ditch and Flagstone Brook is functioning as intended by the *Landfill 5 ROD* (Weston, 1993). Landfill debris, soils, and sediments, including sediments from the Railway Ditch, were excavated between December 1993 and June 1996 from various portions of the base and consolidated in Landfill 5. Post-closure monitoring of surface water and sediment has been conducted in the Railway Ditch and Flagstone Brook. The scope of surface water and sediment monitoring has been reduced over the last five years to focus monitoring activities directly upon contaminants potentially related to Landfill 5 activities (VOCs and site specific metals). Currently, the cleanup goals for sediment are exceeded for lead only at one location within Flagstone Brook.

8.6.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards:</u>

New Hampshire WQC (Env-Ws 1700) were used to establish cleanup goals for metals in surface water in Railway Ditch under the *Landfill 5 ROD* (Weston, 1993). These criteria are periodically updated. Differences between the ROD-specified goals, and the current criteria, are shown in the following table.

Constituent	ROD-Specified Cleanup Goal (μg/L)	Current NH Water Quality Criteria (μg/L)
Arsenic	48	150
Cadmium	0.971	3.1
Copper	9.98	12.1
Lead	2.5	4.7
Mercury	0.012	0.89
Nickel	133	67.2
Zinc	90	154.5

As the table indicates, the changes in criteria do not affect the protectiveness of the remedy, with the exception of the decrease in the criteria for nickel. However, nickel has not been detected above the ROD-specified cleanup goal or current New Hampshire WQC during the period of record. Concentrations of mercury, zinc, cadmium and copper currently meet the ROD specified cleanup goal and would also meet the current New Hampshire WQC. Concentrations of arsenic and lead in surface water in Railway Ditch have exceeded the ROD specified cleanup goal in the past and would also exceed the current New Hampshire WQC.

<u>Changes in Exposure Pathways:</u> There have been no changes in physical conditions, exposure pathways and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Cleanup goals for Railway Ditch and Flagstone Brook were based on ARARs and TBCs. There have been no changes in toxicity or contaminant characteristics that would affect the protectiveness of the remedy.

Changes in Risk Assessment Methods: The human health risk assessment was conducted following EPA and EPA Region 1 guidance. There has not been any significant change in EPA guidance. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: The remedy is meeting RAOs. It is expected that cleanup goals will be achieved in the future.

8.6.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.6.4.4 Technical Assessment Summary

As described above, the remedies at Flagstone Brook and Railway Ditch are functioning as intended. The scope of surface water and sediment monitoring has been significantly reduced, based on trends in detected constituents in these two drainages. Currently monitoring consists of surface water monitoring for VOCs and metals in both drainage areas, and sediment monitoring for metals in Flagstone Brook only. While ARAR changes exist for surface water in Railway Ditch, these changes have not impacted the current protectiveness of the remedy. Only the WQC for nickel is lower than that specified in the ROD. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has been identified that would call into question the protectiveness of the remedy.

8.6.5 ISSUES

The ROD specified cleanup goals were based on the previous New Hampshire WQCs. The updated WQCs are less stringent than the ROD specified goals for all COCs with the exception of one (nickel).

8.6.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine long-term monitoring and reporting of surface water and sediment data should continue in accordance with approved plans. Routine evaluation of long-term data should be performed to optimize long-term monitoring by reducing redundant data points and scope when COCs do not appear to pose a threat to the environment or when cleanup goals are achieved. Changes in the applicable regulatory standards for Flagstone Brook and Railway Ditch COCs should be noted in future long-term monitoring reports.

8.6.7 PROTECTIVENESS STATEMENT

The remedial action at Railway Ditch and Flagstone Brook (excavation of sediment from Railway Ditch and long-term monitoring of sediment and surface water) is currently protective of human health and the environment, and is expected to remain so in the future.

8.6.8 REFERENCES

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1996. *Landfill 5 Remedial Action Report.* (September)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000. *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update.* (August)

Bechtel, 2001a. *Landfill 5 Postclosure Maintenance and Monitoring Plan.* (February)

Bechtel, 2001b. *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report.* (February)

IT, 1995. *Excavation and Relocation of Waste, Soil, and Sediments, Landfills 2, 4, and 5.*

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report.* (June)

MWH, 2003a. *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update.* (March)

MWH, 2003b. *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* (June)

U. S. Air Force, 1997. *Record of Decision for the Brooks/Ditches Operable Unit.* (September)

Weston, 1992a. *Landfill 5 Remedial Investigation Report.* (April)

Weston, 1992b. *Landfill 5 Feasibility Study.* (April)

Weston, 1993. *Landfill 5 Record of Decision.* (September)

Weston, 1995. *Zone 1 Record of Decision.* (July)

9.0 CATEGORY 3 SITES, LONG-TERM MONITORING ONLY, SURFACE WATER/SEDIMENT

9.1 MAP

Category 3 sites addressed in this *Five-Year Review Report* include drainage features associated with Zone 2, Drainage Area G (Peverly Brook), Zone 4, Drainage Area E (Lower Grafton Ditch), and Zone 5, Drainage Areas H and I (Knights Brook and Pickering Brook). The locations of these drainage areas are illustrated in Figure 9.1-1.

9.2 DATA SUMMARY TABLE

Table 9.2-1 summarizes information in this *Five-Year Review Report* for sites in Category 3. The columns in this table include the following information:

Site I.D. – The IRP Zone and site identifier used in the first *Five-Year Review Report* (Bechtel, 1999).

Sites Included – A listing of individual drainage areas included under the IRP Zone/site identifier in this *Five-Year Review Report.*

Site Chronology – A chronological listing of major documents associated with remedial actions performed at the sites.

Background – Description of site location and brief history of site activities that may have resulted in the release of hazardous substances to the environment.

Remedial Actions – Description of cleanup actions performed at the site.

Implementation of Recommendations From Last Five-Year Review – Summary of IRP actions performed during the reporting period (1999 – 2004).

Remarks – Primary document(s) governing remedial actions at the site.

9.3 FIVE-YEAR REVIEW OF CATEGORY 3 SITES

Individual subsections are provided to document the Five-Year Review process for each of the sites included in Category 3. These subsections are organized by IRP Zone/site identifier used in the first *Five Year Review Report* (Bechtel, 1999), and include the following:

- Background information: site description, initial responses, and basis for taking action;
- Remedial/removal action description: regulatory actions, RAOs, remedy description, and remedy implementation;
- Implementation of recommendations from last five year review;
- Technical assessment: answers to Questions A, B, and C in the *Comprehensive Five-Year Review Guidance* (EPA, 2001);
- Issues;
- Recommendations and follow-up actions;
- Protectiveness statements; and
- References.

9.4 ZONE 2, PEVERLY DRAINAGE SYSTEM

9.4.1 BACKGROUND

9.4.1.1 Site Description

The Peverly Brook is the primary drainage feature in Drainage Area G and is shown in Figure 8.4-1 (Bechtel, 1998). The drainage system consists of Peverly Brook and three man-made impoundments: Upper Peverly Pond, Lower Peverly Pond, and Stubbs Pond (formerly Bass Pond), which discharge into Great Bay. Stubbs Pond is currently being managed as an emergent marsh wetland, being drained after the spring runoff to allow for vegetation/feed to grow during the summer/early fall months and then temporarily flooded during the short bird migration season. The Peverly Brook receives surface water and sediment from Landfill-1 (Site 1), Fire Department Training Area-1 (Site 7), Munitions Maintenance Area (Site 12), Construction Rubble Dump-1 (Site 9), and McIntyre Road Drum Disposal Area (Site 43). Figure 9.4-1 shows the Peverly Brook drainage features and monitoring points.

Landfill 1 was the original base landfill and operated from 1953 to 1961. The landfill covers approximately 7 acres. The landfill includes base construction debris (e.g. concrete and soils), which were covered by native soils. Seeps were identified adjacent to the landfill, which discharged to Upper Peverly Pond (Weston, 1995). These seeps were identified as having elevated levels of arsenic, cadmium, and iron.

Fire Department Training Area-1 was the main fire training area between 1956 and 1961. There are no obvious drainage pathways from this site and precipitation has been observed to rapidly infiltrate through the coarse-grained surface soils (Bechtel, 1998).

The Munitions Maintenance Area contained a weapons storage area, two USTs, and a gasoline UST. Closure activities at the site included removal of the USTs (Bechtel, 1998). Construction Rubble Dump-1 served as soils borrow area and as a disposal site for construction debris (concrete, asphalt, wood, tree stumps, brush, and scrap metal). Investigations at the site did not reveal the presence of contaminant source areas at the site (Weston, 1994).

The McIntyre Road Drum Disposal Area contained 55-gallon drums and 5-gallon cans labeled concrete joint sealant. The 55-gallon drums were suspected to contain leaded fuel sludge, but no evidence of contamination was found. Potential sources of contamination (drums and cans) were excavated and disposed of at an off-base facility (Bechtel, 1998).

Historical analytical results for surface water and sediment in the drainage area are discussed in the *Zone 2 ROD* (Weston, 1995). The analytical results indicate that the primary contaminants in the drainage are metals (aluminum, arsenic, iron, lead, manganese, nickel, and zinc) and pesticides (DDT related compounds and lindane). A source for the metals contamination was not defined in the ROD. Pesticide concentrations were attributed to basewide pesticide usage and to pre-Air Force base activities, and were not considered related to Zone 2 activities.

9.4.1.2 Initial Response

No remedial action was performed at Peverly Brook prior to the finalization of the *Zone 2 ROD* (Weston, 1995).

9.4.1.3 Basis for Taking Action

The *Zone 2 ROD* (Weston, 1995) evaluated potential risks to human and ecological receptors for surface water and sediment. The results of this evaluation indicated that human health risks from surface water and sediment posed by the chemicals of concern were within the EPA range of acceptable risks. The *Zone 2 ROD* also states that risk from recreationally caught catfish and bass from Stubbs Pond were evaluated and there was no apparent risk of significant adverse health effects through the ingestion of these species (Weston, 1995).

However, a limited ecological risk was found to be posed by sediment in the drainage. The ecological risk assessment (ERA) concluded there was a potential for harmful effects to the Belted Kingfisher from ingestion of contaminated fish. The ERA indicated that the potential risk to the kingfisher was primarily associated with ingestion of fish contaminated with zinc and arsenic from Stubbs Pond (formerly Bass Pond) (Weston, 1993). Fish ingested from both Upper and Lower Peverly Ponds contributed less than 10 percent to the cumulative hazard indices (Weston, 1993). Fish tissue sampling was performed in 1992 (limited), 1996 and 2001.

The ROD concluded that because of the limited extent and magnitude of contamination, and the potential greater adverse impact that would be caused by excavation of the sediment, no remedial action was proposed other than monitoring of surface water, sediment, and fish tissue in the drainage.

The ROD also addressed the presence of pesticides in the drainage area sediment. It was concluded that the pesticides were the result of basewide application and were not the result of a CERCLA-regulated release. Because of this, no cleanup goals for pesticides in Zone 2 sediments were necessary.

9.4.2 REMEDIAL/REMOVAL ACTIONS

9.4.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Zone 2 Record of Decision (1995)

The *Zone 2 ROD* (Weston, 1995) concluded that because of the limited extent and magnitude of contamination, and the potential greater adverse impact that would be caused by excavation of the sediment, no remedial action was proposed other than monitoring of surface water, sediment, and fish tissue in the drainage.

9.4.2.2 Remedial Action Objectives

The *Zone 2 ROD* (Weston, 1995) identified the following general Zone 2 RAOs relevant to the Peverly Drainage System:

- Surface water and sediment – Monitoring of surface water and sediment quality over time in Upper and Lower Peverly and Bass Ponds over time (Weston, 1995).

The cleanup goals established in the Zone 2 ROD for surface water and sediment within the Peverly Brook drainage are included in Table 9.4-1 and Table 9.4-2, respectively.

9.4.2.3 Remedy Description

The Zone 2 ROD required no further action other than monitoring of surface water, sediment, and fish tissue in this drainage.

9.4.2.4 Remedy Implementation

Surface water and sediment monitoring is performed annually at a total of nine sample stations (24-815, 24-8014, 24-8015, 24-8016, 24-8018, 24-8019, 24-8098, 8103A, and 24-8105). The monitoring of surface water at stations 24-8014, 24-8015, 24-8016, 24-8018, 24-8019, 24-8098, 8103A, and 24-8105 satisfies the requirements of the Landfill 1 GMP.

Surface water at Peverly Brook and Upper Peverly Pond has been historically monitored for inorganics and pesticides. Currently, surface water within the Peverly Brook drainage is monitored for site specific metals (aluminum, arsenic, iron, lead, manganese, and zinc) as specified in the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a). Metals in surface water continue to be detected above the ROD specified cleanup goals for Peverly Brook and Peverly Pond. These exceedances of the cleanup goals for surface water are likely driven by variations in conditions local to the sampling station and are the result of varying amounts of both total and dissolved solids in the sample.

Sediment at Peverly Brook and Upper Peverly Pond has been historically monitored for organics, inorganics and pesticides. Currently, sediment within the Peverly Brook drainage is monitored for site specific metals (arsenic, lead, nickel, and zinc) and pesticides at select locations as specified in the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a). The pesticide compounds 4,4'-DDD and 4,4'-DDE continue to be detected within sediment from Peverly Brook drainage. Site specific metals have also been detected above the ROD specified cleanup goals for Peverly Brook and Peverly Pond during recent monitoring events.

Fish tissue sampling was performed in 1992 (limited), 1996 and 2001. The results of the most recent fish tissue sampling indicated both inorganics and pesticides present within fish tissue in the Peverly drainage. However, evaluation of the data indicated ecological risks due to site-related contaminants are likely significantly less than estimated in the Zone 2 ERA in 1993 (MWH, 2002). Additionally, no human health risks were identified in the initial risk assessment and currently no consumption of fish from the drainage areas occurs.

9.4.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedies for Zone 2 remained protective of human health and the environment. Annual evaluation of environmental monitoring data was recommended to evaluate opportunities for optimization and progress toward cleanup goals. Surface water and sediment monitoring in the Zone 2 drainage areas has been performed as required, and the results of monitoring were documented in:

- *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report.* Bechtel, 2001 (February)
- *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report.* MWH, 2002 (June)
- *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* MWH, 2003b (June)

Optimization of monitoring efforts is documented in:

- *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update.* Bechtel, 2000. (August)
- *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update.* MWH, 2003a (March)

The scope of surface water and sediment monitoring was reduced in 2003 to focus monitoring upon contaminants directly related to Zone 2 activities. Surface water and sediment monitoring was reduced from the analysis of all metals to monitoring for a site specific list of metals. Additionally, sediment monitoring for pesticides in Peverly Brook was eliminated at some locations within the program, but continues to be performed at sample stations 24-8014, 24-8015 and 24-8019. Evaluation of the most recent fish tissue data indicated ecological risks due to site-related contaminants are likely significantly less than estimated in the Zone 2 ERA in 1993.

9.4.4 TECHNICAL ASSESSMENT

9.4.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The chosen remedy for Peverly Brook is functioning as intended by the *Zone 2 ROD* (Weston, 1995). The *Zone 2 ROD* concluded that neither surface water nor sediment posed unacceptable human health risks, and only limited ecological risk. Long-term monitoring of surface water and sediment has been conducted in Peverly Brook since the adoption of the

Zone 2 ROD. The scope of surface water monitoring was reduced in 2003 to focus monitoring upon Zone 2 site specific COCs.

9.4.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards :

Surface Water. Cleanup goals for surface water were based on ARARs (e.g., New Hampshire WQC (Env-Ws 1700) (arsenic and zinc) and background values (aluminum, iron, lead, manganese). New Hampshire WQC have been revised since the time of the ROD, as shown below.

Constituent	**ROD-Based Cleanup Goal (µg/L)**	**Current New Hampshire WQC (µg/L)**
Arsenic	Practical Quantitation Limit	150
Zinc	72.9*	82.4*

*Based on hardness of 64.3 mg/L from *Zone 2 ROD*.

Sediment. Cleanup goals for sediment were based on background values (nickel and lead) and NOAA ERLs (arsenic and zinc).

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Evaluation of fish tissue data using updated and widely accepted toxicity reference values indicated ecological risks due to site-related contaminants are likely significantly less than estimated in the Zone 2 ERA in 1993 (MWH, 2002).

Changes in Risk Assessment Methods: The human health risk assessment for Zone 2 was conducted following EPA and EPA Region 1 guidance. There has not been any significant change in EPA guidance that could result in significant revisions to calculated cleanup goals.

The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals

Expected Progress Toward Meeting RAOs: The ROD-specified RAO of monitoring of surface water and sediment quality over time is being achieved.

9.4.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

9.4.4.4 Technical Assessment Summary

As described above, the remedy at Peverly Brook is functioning as intended. The Zone 2 ROD required no further action other than monitoring of surface water, sediment, and fish tissue in this drainage. Long-term monitoring of surface water and sediment has been conducted in Peverly Brook since the adoption of the *Zone 2 ROD* meeting the RAO established for the drainage area in the *Zone 2 ROD*. While ARAR changes exist for surface water in Peverly Brook, these changes have not impacted the protectiveness of the remedy. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has been identified that would call into question the protectiveness of the remedy.

9.4.5 ISSUES

Cleanup goals for surface water and sediment were established for Peverly Brook in the *Zone 2 ROD*. However, no remedial objective was included in the ROD to specifically address surface water and sediment beyond routine monitoring. Metals in surface water continue to be detected above the ROD specified cleanup goals for Peverly Brook and Peverly Pond. Long-term monitoring data also indicate that metals in sediment continue to be detected above cleanup goals. It is not anticipated that concentrations of inorganic constituents in sediment will decrease rapidly over time.

9.4.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine long-term monitoring of surface water and sediment should continue. Routine evaluation of long-term data should be performed to optimize long-term monitoring activities. The rationale behind establishment of surface water and sediment cleanup goals for Peverly Brook should be reevaluated by the BCT prior to the next annual report, given that monitoring is the only objective stated in the Zone 2 ROD.

9.4.7 PROTECTIVENESS STATEMENT

The remedial action at Peverly Brook (long-term monitoring of sediment and surface water) is currently protective of human health and the environment, and is expected to remain so in the future.

9.4.8 REFERENCES

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1998. *Pease Air Force Base Basewide Surface Water Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan*. (April)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base*. (September)

Bechtel, 2000. *Basewide Surface Water, Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan – Year 2000 Update*. (August)

Bechtel, 2001. *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report*. (February)

EPA, 2001. Comprehensive Five-Year Review Guidance, EPA 540-R-01-007.

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report*. (June)

MWH, 2003a. *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update*. (March)

MWH, 2003b. *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* (June)

Weston, 1993. *Zone 2 Remedial Investigation Report.* (November)

Weston, 1994. *Zone 5 Record of Decision.* (September)

Weston, 1995. *Zone 2 Record of Decision.* (September)

9.5 ZONE 4, LOWER GRAFTON DITCH

9.5.1 BACKGROUND

9.5.1.1 Site Description

Grafton Ditch (upper and lower) is the primary drainage feature in Drainage Area E (Bechtel, 1998a), which is shown on Figure 8.4-1. This drainage area receives surface water and sediment from the former Jet Engine Test Cell (Site 34), ,the former Auto Hobby Shop (Site 40), Landfill-6 (Site 6), and Construction Rubble Dump-2 (Site 17).

The headwaters of Grafton Ditch are located adjacent to the Jet Engine Test Cell (Site 34). The ditch is an open surface drainage for approximately 700 feet until it enters a storm drain. This portion of the ditch is referred to as Upper Grafton Ditch. Surface water flows through the storm drain system for approximately 3,000 feet until it discharges to another open surface drainage east of Grafton Drive. This portion of the drainage is referred to as Lower Grafton Ditch. Lower Grafton ditch converges with Hodgson Creek approximately 500-feet west of Landfill 6 and then flows east and eventually discharges to the Piscataqua River by the way of North Mill Pond. The Grafton Ditch site features and long-term monitoring locations are shown in Figure 9.5-1.

The *Zone 4 ROD* (Weston, 1995a) identified three primary contributors to surface water quality of Grafton Ditch: surface water runoff from Landfill-6 and Construction Rubble Dump 2, and runoff from the industrial areas in Zone 3.

Landfill 6 reportedly received domestic and industrial solid wastes during the 1970's. These wastes may have also included spent paint thinners and solvents (Bechtel, 1997). The primary contaminants identified at Landfill-6 were aromatic hydrocarbons (BTEX and dichlorobenzene), PAHs, TPHs, and metals (Weston, 1995a).

Construction Rubble Dump 2 reportedly received construction debris from 1952 through 1987. Materials including asphalt, concrete, plastic, wood, rubber, cloth, wire, metal, and other construction materials have been observed in the fill (Bechtel, 1997). The primary contaminants identified were PAHs and TPHs (Weston, 1995a).

The *Zone 3 ROD* indicated that the Jet Engine Test Cell (Site 34) contributed PAHs and BTEX related compounds, and metals to Upper Grafton Ditch. Additionally, aerial fallout of combustion products from aircraft engines and local heating and industrial activities were identified as having contributed to this contamination (Weston, 1995b).

9.5.1.2 Initial Response

No remedial action was performed at Peverly Brook prior to the finalization of the *Zone 4 ROD* (Weston, 1995a) and the *Zone 3 ROD* (Weston, 1995b).

9.5.1.3 Basis for Taking Action

The RI report for Zone 4 was completed in September 1993. The RI documented the presence of buried wastes and contamination in soil, groundwater, surface water and sediment in the areas surrounding Landfill 6. Both organic and inorganic contaminants were detected in surface water and sediment within the Grafton Ditch drainage during RI activities.

9.5.2 REMEDIAL/REMOVAL ACTIONS

9.5.2.1 Regulatory Actions

Grafton Ditch is covered by two RODs: the *Zone 4 ROD* covers Lower Grafton Ditch and the *Zone 3 ROD* covers Upper Grafton Ditch:

Zone 4 Record of Decision (1995)

The *Zone 4 ROD* concluded that surface water and sediment in Lower Grafton Ditch did not pose unacceptable risks to human receptors. An ecological risk assessment indicated that some chemicals posed a marginal risk to ecological receptors; however, these were determined not to be site related. It was concluded that remedial action was not required for Lower Grafton Ditch, and there was not a need to establish cleanup goals for surface water and sediment. Surface water and sediment monitoring in the ditch was included as part of the Landfill 6 selected remedial alternative (Weston, 1995a).

Zone 3 Record of Decision (1995)

The *Zone 3 ROD* concluded that neither surface water nor sediment posed an unacceptable risk to human receptors in Upper Grafton Ditch. However, the ROD concluded that both surface water and sediment posed an unacceptable risk to ecological receptors. The selected remedial alternative included excavation and disposal of sediment exceeding cleanup goals from Upper Grafton Ditch. This remedial action was completed in 1996 (Bechtel, 1998b). Following this remedial action, no further monitoring of surface water and sediment in Upper Grafton Ditch would be required (Weston, 1995b).

9.5.2.2 Remedial Action Objectives

The *Zone 4 ROD* identified the following general Zone 4 RAOs relevant to Lower Grafton Ditch:

- No remedial action for surface water or sediment in Lower Grafton; and
- Long-term monitoring of surface water and sediment in Lower Grafton (Weston, 1995a).

The *Zone 3 ROD* identified the following general Zone 3 RAO relevant to Upper Grafton Ditch:

- Protect ecological receptors from direct contact with, or ingestion of, sediment containing contaminants at concentrations that may present a potential unacceptable risk (Weston, 1995b).

The cleanup goals established in the *Zone 3 ROD* for sediment within the Upper Grafton Ditch drainage are included in Table 9.5-1. No cleanup goals were established for Lower Grafton Ditch, where long-term monitoring was required by the *Zone 4 ROD*.

9.5.2.3 Remedy Implementation

Remedial actions in the vicinity of Lower Grafton Ditch included excavation and removal of materials from Landfill 6 between 1995 and 1996 (Bechtel, 1997) and installation of a cap on CRD-2 in 1995 (Weston, 1995b). No surface water or sediment remedial actions were performed in Lower Grafton Ditch. Remedial actions in the vicinity of Upper Grafton Ditch included excavation of sediment exceeding the ROD cleanup goals for sediment and offsite disposal. This work was performed between September and December 1996 (Bechtel, 1998b).

Six permanent monitoring stations (20-810, 20-8185, 20-809, 20-8131, 20-808, and 20-8133) have been established in Lower Grafton Ditch. Currently, long-term monitoring within Lower Grafton Ditch is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a). Surface water monitoring for VOCs and metals is performed at locations 20-808, 20-8131, and 20-8133, as shown on Figure 9.5-1. Monitoring of station 20-810 was discontinued after the May 2000 sampling event because it was deemed redundant with station 8185. Monitoring of stations 20-809 and 20-8185 was discontinued in 2003 at the recommendation of the EPA and as noted in the Agency's comments on the *2001 Annual Report* (MWH, 2002).

Long-term monitoring data to date indicate that no occurrences of VOCs exceeding the New Hampshire WQC have been recorded in the period of record (MWH, 2003b). Several metals (aluminum, beryllium, cadmium, chromium, copper, iron, lead, nickel and zinc) have been detected above the New Hampshire WQC during recent sampling events (MWH, 2003b).

9.5.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999) concluded that the remedies for Zone 3 and Zone 4 remained protective of human health and the environment. Annual evaluation of environmental monitoring data was recommended to evaluate the effectiveness of the Landfill 6 remedy and to identify opportunities for optimization of long-term monitoring activities. Surface water and sediment monitoring in the Lower Grafton Ditch drainage area has been performed as required, and the results of monitoring were documented in:

- *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report*. Bechtel, 2001. (February)
- *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report*. MWH, 2002. (June)

- *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* MWH, 2003. (June)

Optimization of long-term monitoring activities is documented in:

- *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update.* Bechtel, 2000. (August)
- *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update.* MWH, 2003. (March)

The scope of surface water and sediment monitoring was reduced in 2000 and again in 2003 to eliminate redundant data points and to focus monitoring upon contaminants most likely to be directly related to Landfill 6 activities. Surface water and sediment monitoring was eliminated completely at locations 20-810, 20-809 and 20-8185. Sediment monitoring was eliminated at location 20-8131. Surface water continues to be monitored at locations 20-808, 20-8131, and 20-8133 (Figure 9.5-1).

9.5.4 TECHNICAL ASSESSMENT

9.5.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The chosen remedy for Grafton Ditch is functioning as intended by the *Zone 3 ROD* (Weston, 1995b) and the *Zone 4 ROD* (Weston, 1995a). Sediment exceeding the Zone 3 ROD cleanup goals for sediment was removed from Upper Grafton Ditch between September and December 1996 (Bechtel, 1998b), and materials from Landfill 6 were excavated and removed between 1995 and 1996 (Bechtel, 1997). Long-term monitoring of surface water and sediment has been conducted in Lower Grafton Ditch to meet the RAOs for surface water and sediment established in the *Zone 4 ROD*. The scope of surface water and sediment monitoring was reduced in 2000 and again in 2003 to eliminate redundant data points and to focus monitoring upon contaminants directly related to Landfill 6 activities. (VOCs and metals). All sediment monitoring was discontinued in 2003, because remaining concentrations of COCs were not believed to be the result of Landfill 6 activities.

9.5.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards :</u>

Surface Water. No cleanup goals were developed for Lower Grafton Ditch, where LTM currently occurs.

Sediment. Sediments exceeding Zone 3 ROD cleanup goals in Upper Grafton Ditch were excavated in 1996. No sediment cleanup goals were established for Lower Grafton Ditch under the Zone 4 ROD.

<u>Changes in Exposure Pathways:</u> There have been no changes in physical conditions, exposure pathways and land use that would affect the protectiveness of the remedy.

<u>Changes in Toxicity and Other Contaminant Characteristics:</u> Risk-based cleanup goals were not established for the sites; therefore, there have been no changes in toxicity or contaminant characteristics that would affect the protectiveness of the remedy.

<u>Changes in Risk Assessment Methods:</u> The human health risk assessments for Zone 3 and Zone 4 were conducted following EPA and EPA Region 1 guidance. There has not been any significant change in EPA guidance that could result in significant revisions to calculated cleanup goals. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessments that were conducted are consistent with current guidance and would not result in significant revisions to cleanup goals.

<u>Expected Progress Toward Meeting RAOs:</u> The ROD-specified RAO of monitoring of surface water and sediment quality over time is being achieved.

9.5.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

9.5.4.4 Technical Assessment Summary

As described above, the remedy at Grafton Ditch is functioning as intended. Sediment exceeding the *Zone 3 ROD* cleanup goals was removed from Upper Grafton Ditch, and long-term monitoring of surface water and sediment has been conducted in Lower Grafton Ditch to meet the RAOs for surface water and sediment established in the *Zone 4 ROD*. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has been identified that would call into question the protectiveness of the remedy.

9.5.5 ISSUES

No issues were identified for Grafton Ditch.

9.5.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine long-term monitoring and reporting of surface water for metals should continue in accordance with approved plans. Additionally, a routine review of the monitoring objectives and evaluation of the long-term monitoring data should be conducted to determine the point at which monitoring can be reduced or discontinued.

9.5.7 PROTECTIVENESS STATEMENT

The remedial action at Grafton Ditch (excavation of sediment and long-term monitoring of sediment and surface water) is currently protective of human health and the environment, and is expected to remain so in the future.

9.5.8 REFERENCES

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1997. *Construction Rubble Dump-2 Landfill Cap Postclosure Maintenance and Monitoring Plan.* (April)

Bechtel, 1998a. *Pease Air Force Base Basewide Surface Water Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan* (April)

Bechtel, 1998b. *Zone 3 Excavations Remedial Action Report.* (March)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000. *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update.* (August)

Bechtel, 2001. *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report.* (February)

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report.* (June)

MWH, 2003a. *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update.* (March)

MWH, 2003b. *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* (June)

Weston, 1995a. *Zone 4 Record of Decision.* (January)

Weston, 1995b. *Zone 3 Record of Decision.* (September)

9.6 ZONE 5, KNIGHTS BROOK AND PICKERING BROOK

9.6.1 BACKGROUND

9.6.1.1 Site Description

Discussion of Drainage Areas H and I are combined in this report since both drainage features are associated with Site 8 and monitoring within both drainage areas is required by the *Record of Decision for Site 8 (Site 8 ROD)* (Weston, 1994). Both drainage areas are shown in Figure 8.4-1. Pickering Brook receives surface water and sediment from most of Fire Department Training Area-2 (Site 8), a portion of the Field Maintenance Squadron Equipment Cleaning Site (Site 11), and a small portion of the northeast corner of the Flightline Area. Pickering Brook flows off-base to the north and joins Flagstone Brook. Flagstone Brook ultimately discharges into the Piscataqua River (Figure 9.6-1).

Knights Brook receives surface water and sediment from a small portion of Site 8. The headwaters for Knights Brook originate from both Pickering and Watering Springs. Each of these water bodies are located to the northwest of Site 8, entirely outside the Pease AFB site boundary. Surface water from Watering and Pickering Springs flows into two separate wetlands, which comprise the headwaters for Knights Brook. Drainage from the two wetlands converges and flows north to Little Bay (Figure 9.6-1).

Virtually all of Site 8 is contained in the Pickering Brook drainage; however, it is suspected that groundwater from Site 8 discharges into the Knights Brook drainage. According to the *Site 8 ROD* (Weston, 1994), cis-1,2-dichloroethene (cis-1,2-DCE) and TCE were detected in surface water at Knights Brook and in Site 8 bedrock wells, located upgradient of the brook. The presence of these contaminants has been attributed to past activities conducted at Site 8.

Site 8 was operated as a fire training area from 1961 to 1988; two former burn areas are the primary contaminant source areas within the site. Before 1971, mixed waste oils, solvents, and fuels were collected from various locations across the base and burned at Site 8 as one method of disposal. Burning procedures involved saturating the burn pit with water, and pouring waste oils, solvents, or fuels on top of the water or a mock aircraft. The mixture was burned for a period of 1 to 2 minutes and then extinguished using an aqueous foam. In the mid 1970s, the practice of mixing waste oils and solvents with fuel for training ceased, and only JP-4 was used. At the same time, an underground sprinkler and drainage system was added to the burn area so that JP-4 could be sprayed into the pit area through an underground fuel line. Excess fuel was discharged to a drainage ditch located at the north end of Site 8, which drains to Pickering Brook.

9.6.1.2 Initial Response

The RI process at Site 8 was conducted in three stages from 1984 to 1992. As part of the Interim Remedial Measures (IRMs) associated with the RI process, approximately 260 tons of contaminated sediment were removed from a drainage ditch in 1990 and were disposed off-base at a licensed disposal facility (Weston, 1994).

9.6.1.3 Basis for Taking Action

In 1983, an IRP Phase 1 Problem Identification/Records Search was conducted at Pease AFB. As a result of the Phase 1 report and subsequent presurvey work, a RI was conducted at Site 8 in accordance with CERCLA requirements (Weston, 1992). The investigation was conducted in three stages from 1984 to 1992. The RI identified areas of free-phase product, soil, and groundwater contamination at Site 8. Pesticides, PAHs and metals were detected in Pickering Brook and low levels of VOCs and PAHs were detected in the sediment from Knights Brook (Weston, 1994).

9.6.2 REMEDIAL/REMOVAL ACTIONS

9.6.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Site 8 Record of Decision (1994)

Risk assessments were performed for surface water and sediment and presented in *the Site 8 ROD* for Knights and Pickering Brooks. The risk assessments did not reveal exposures that resulted in unacceptable risks to human or ecological receptors. As a result, cleanup goals were not established for surface water and sediment in Knights and Pickering Brooks.

However, the chosen remedy for Site 8 detailed in the ROD requires monitoring of surface water and sediment in Knights and Pickering Brooks (Weston, 1994).

9.6.2.2 Remedial Action Objectives

The *Site 8 ROD* did not identify RAOs specific to surface water and sediment in Knights and Pickering Brooks. The following RAO specific to groundwater at Site 8 also affects surface water:

- Prevent discharge of contaminated groundwater to surface water bodies where it may present increased risks to human health and the environment.

9.6.2.3 Remedy Description

The *Site 8 ROD* concluded that neither surface water nor sediment posed unacceptable risks and that clean-up goals were unnecessary for these media. However, the chosen remedy for Site 8 detailed in the ROD requires monitoring of surface water and sediment in Knights and Pickering Brooks (Weston, 1994).

9.6.2.4 Remedy Implementation

Three permanent monitoring stations (99-015, 28-8028 and 28-8029) have been established in Knights Brook and two permanent monitoring stations (27-8026 and 27-8027) have been established in Pickering Brook, as shown on Figure 9.6-1. Currently, long-term monitoring within Knights and Pickering Brooks is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a).

Surface water within Knights Brook is currently monitored for VOCs at location 99-015. To date, VOCs have not been detected above the New Hampshire WQC (Env-Ws 1700) (MWH, 2003b) at location 99-015. Monitoring of surface water at location 99-015 continues to be conducted as part of the current long-term monitoring plan. The Air Force proposed the cessation of surface water and sediment sampling at locations 28-8028 and 28-8029 as well as the sediment monitoring at location 99-015 in the *2001 Annual Report* (MWH, 2002). These recommendations were based upon the fact that the *Site 8 ROD* concluded that neither surface water nor sediment pose unacceptable human or ecological risk. The EPA and NHDES approved this recommendation and surface water monitoring was discontinued at Knights Brook beginning in 2003.

Surface water and sediment are currently monitored for site specific metals (mercury, nickel, lead, and zinc) within Pickering Brook. Lead is the only site-specific metal that has been detected in surface water above the New Hampshire WQC during long-term monitoring activities at Pickering Brook.

Site specific metals (mercury, nickel, lead, and zinc) have been detected above NOAA ER-L values at a frequency of approximately 50% or less during the period of record (MWH, 2003b). The Air Force recommended the cessation of sediment sampling for SVOCs within Pickering Brook (27-8026 and 27-8027) in the *2001 Annual Report* (MWH, 2002). The EPA and NHDES approved this recommendation and sediment monitoring was discontinued at Pickering Brook beginning in 2003.

9.6.3 IMPLEMENTATION OF RECOMMENDATIONS FROM LAST FIVE-YEAR REVIEW

The first *Five-Year Review Report* (Bechtel, 1999), concluded that the remedies for Site 8 remained protective of human health and the environment. Annual evaluation of environmental monitoring data was recommended to evaluate the effectiveness of the Site 8 remedy and to identify opportunities for optimization of long-term monitoring activities. Surface water and sediment monitoring in the Knights Brook and Pickering Brook drainage areas has been performed as required, and the results of monitoring were documented in:

- *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report.* Bechtel, 2001. (February)

- *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report*. MWH, 2002 (June)

- *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* MWH, 2003 (June)

Changes to the long-term monitoring program were documented in:

- *Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Long-Term Monitoring Plan – Year 2000 Update*. Bechtel, 2000 (August)
- *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update*. MWH, 2003 (March)

As is described under Section 9.6.2.4 above, the scope of surface water and sediment monitoring was reduced in 2003, because concentrations of constituents were routinely detected at concentrations below applicable criteria. Surface water and sediment monitoring was eliminated completely within Knights Brook, with the exception of surface water monitoring location 99-015 (Figure 9.6-2). Surface water and sediment continue to be monitored within Pickering Brook for site specific metals.

9.6.4 TECHNICAL ASSESSMENT

9.6.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The *Site 8 ROD* concluded that neither surface water nor sediment posed unacceptable risks and that clean-up goals were unnecessary for these media, but the *ROD* included monitoring of surface water and sediment as a component of the overall Site 8 remedy. Long-term monitoring of surface water and sediment has been conducted in both Knights and Pickering Brooks since the adoption of the *Site 8 ROD*. Monitoring of sediment was discontinued and the scope of surface water monitoring was reduced in 2003 based upon lack of detection of organic and inorganic constituents above the comparison criteria. Monitoring has indicated little impact to these drainage areas from historical Site 8 activities.

9.6.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: No cleanup standards were established for surface water and sediment in Knights Brook or Pickering Brook.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways and land use that would affect the protectiveness of the remedy

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in toxicity values or other contaminant characteristics that would affect the protectiveness of the remedy.

Changes in Risk Assessment Methods: The human health risk assessment for Site 8 was conducted following EPA and EPA Region I guidance. There has not been any significant change in EPA guidance that could result in significant revisions to calculated cleanup goals. The EPA has issued several guidance documents on conducting ecological risk assessments since 1997. However, the ecological risk assessment that was conducted is consistent with current guidance and would not result in significant revisions to cleanup goals.

Expected Progress Toward Meeting RAOs: No specific surface water and sediment RAOs were established for Pickering and Knights Brooks. The Site 8 groundwater RAO to prevent discharge to surface water is being met and is expected to be met in the future.

9.6.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

9.6.4.4 Technical Assessment Summary

As described above, the remedy at Knights and Pickering Brooks is functioning as intended. Monitoring of surface water and sediment at Knights and Pickering Brooks is performed as a component of the overall Site 8 remedy. Potentially site-related organic and inorganic constituents have rarely been reported above comparison criteria, indicating little impact to these drainage areas from Site 8 activities. The Site 8 groundwater RAO to prevent discharge to surface water is being met and is expected to be met in the future. No other information has been identified that would call into question the protectiveness of the remedy.

9.6.5 ISSUES

No issues were identified for Knights Brook and Pickering Brook.

9.6.6 RECOMMENDATIONS AND FOLLOWUP ACTIONS

Routine long-term monitoring and reporting of surface water data should continue in accordance with approved plans. Additionally, a routine review of the monitoring objectives and evaluation of the long-term monitoring data should be conducted to determine when discontinuation of monitoring is warranted, based on demonstrated lack of adverse impact to Knights/Pickering Brooks.

9.6.7 PROTECTIVENESS STATEMENT

Long-term monitoring of Knights and Pickering Brooks indicates that the remedial activities performed to date at Site 8 have been protective of human health and the environment related to potential exposures to surface water and sediment in these drainage areas. This protectiveness is expected to continue in the future.

9.6.8 REFERENCES

AFBCA, 2002. *Draft Final Land Use Control/Institutional Control Management Plan*, Pease Air Force Base. (October)

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base.* (September)

Bechtel, 2000. *Basewide Surface Water, Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan – Year 2000 Update.* (August)

Bechtel, 2001. *Pease AFB Basewide Surface Water, Sediment, and Fish Tissue Monitoring 1999/2000 Annual Report.* (February)

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report.* (June)

MWH, 2003a. *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update.* (March)

MWH, 2003b. *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report.* (June)

Weston, 1992. *Site 8 Remedial Investigation.* (November)

Weston, 1994. *Record of Decision for Site 8.* (September)

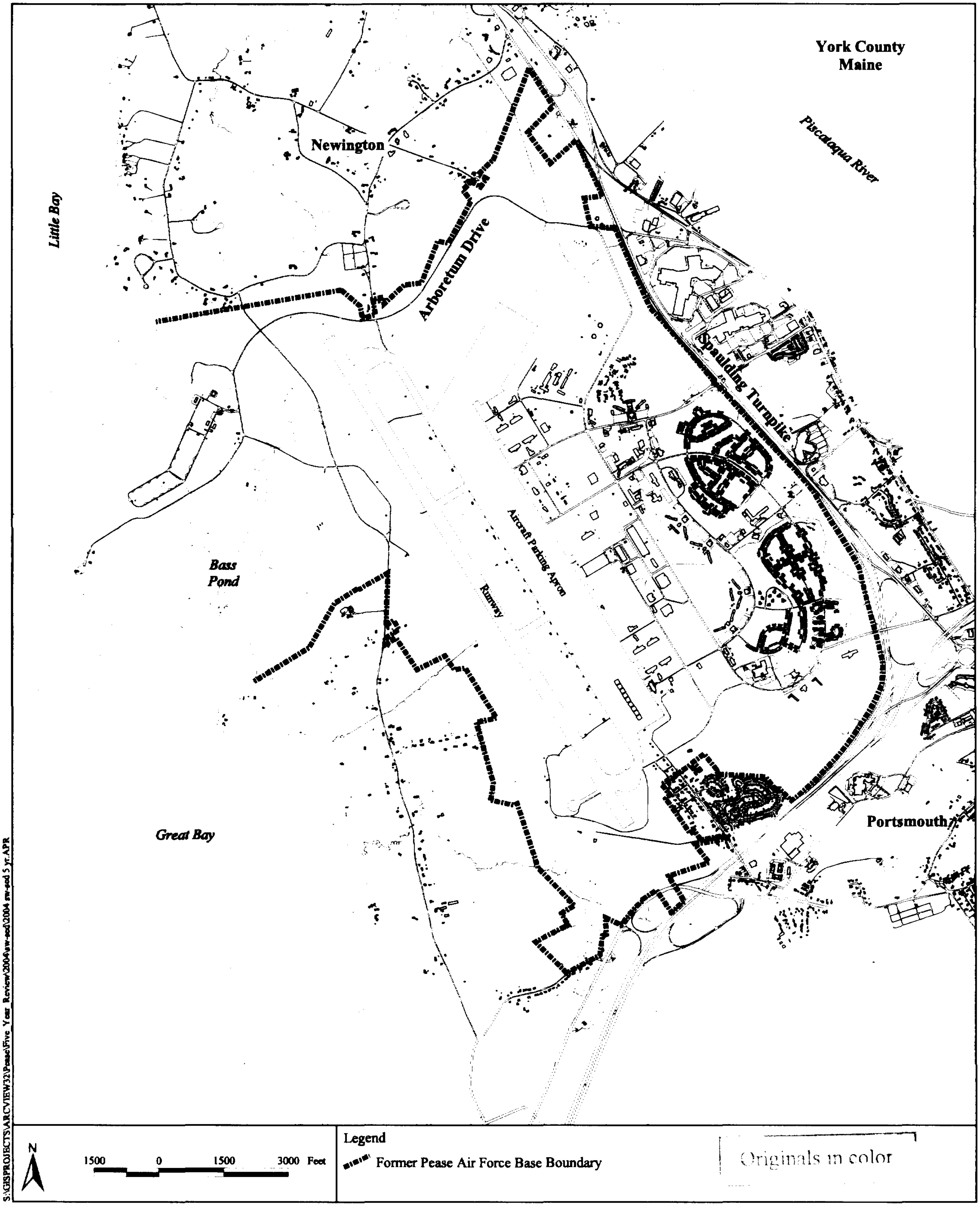
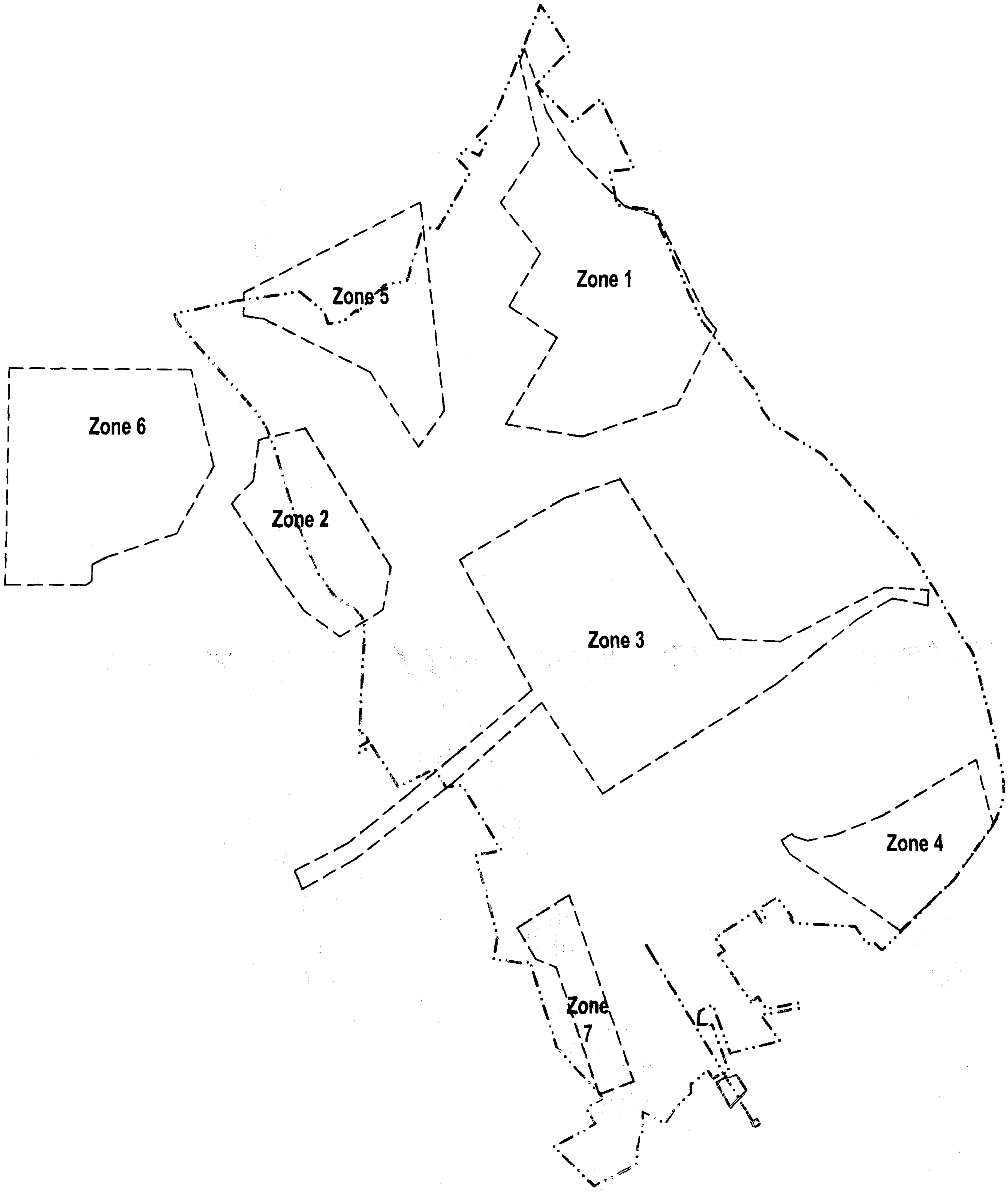


Figure 5-1
Pease AFB
Site Location Map

5 Year Review Report
Former Pease AFB
Portsmouth, New Hampshire



LEGEND

ZONE BOUNDARY

WETLAND RESTORATION/PRESERVATION AREA

STREAM/DITCH

FORMER BASE BOUNDARY

north

0 500 1000 2000

SCALE: FEET
1"=2000'

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

IRP ZONES

MWH

FIGURE 5-2

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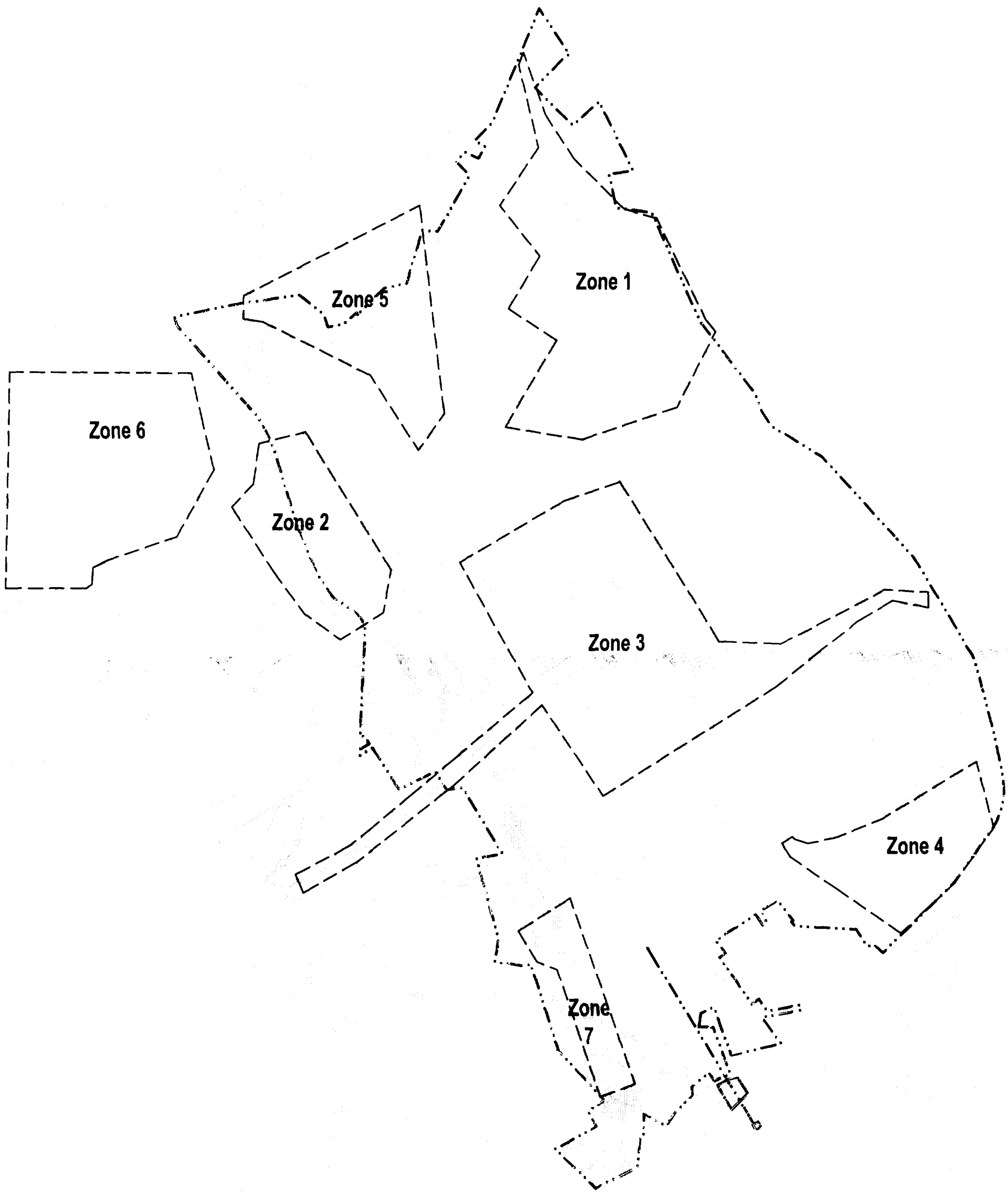

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LEGEND

— — — — — —	ZONE BOUNDARY
	WETLAND RESTORATION/PRESERVATION AREA
	STREAM/DITCH
—— · · ——	FORMER BASE BOUNDARY

north

0 500 1000 2000

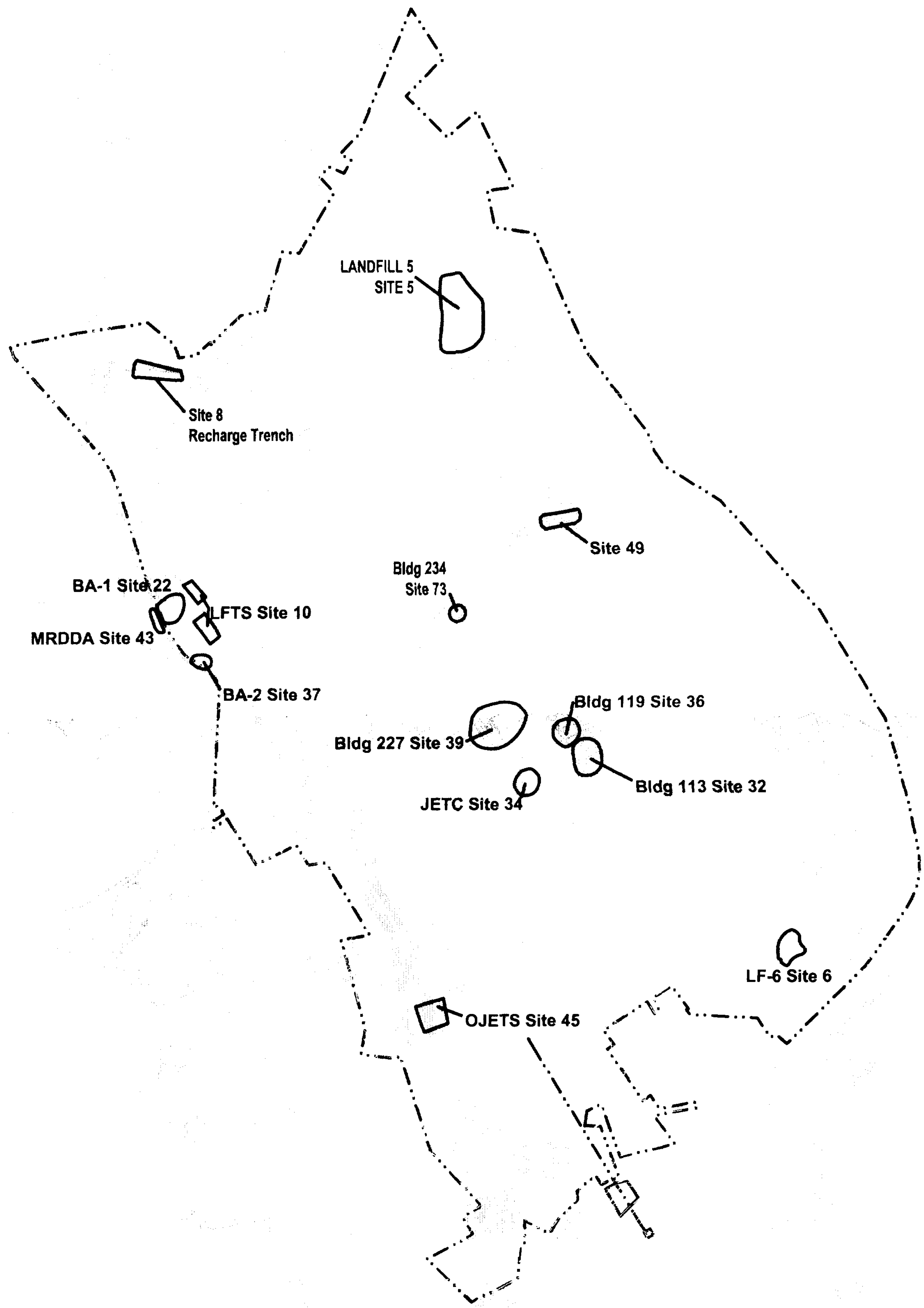
SCALE: FEET
1"=2000'

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

IRP ZONES

MWH

FIGURE 6.1-1



LEGEND

SITE LOCATION

WETLAND RESTORATION/PRESERVATION AREA

STREAM/DITCH

FORMER BASE BOUNDARY

north

0 500 1000 2000

SCALE: FEET
1"=2000'

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

CATEGORY 1 SITE LOCATIONS

MWH

FIGURE 7.1-1

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TARGET SHEET

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DOC ID: 65334/204871
DATE: September, 2004
TITLE: LAND USE Fig. 6.1-2
DESCRIPTION: FORMER PEASE AIR FORCE BASE, 5 YEAR REVIEW REPORT

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
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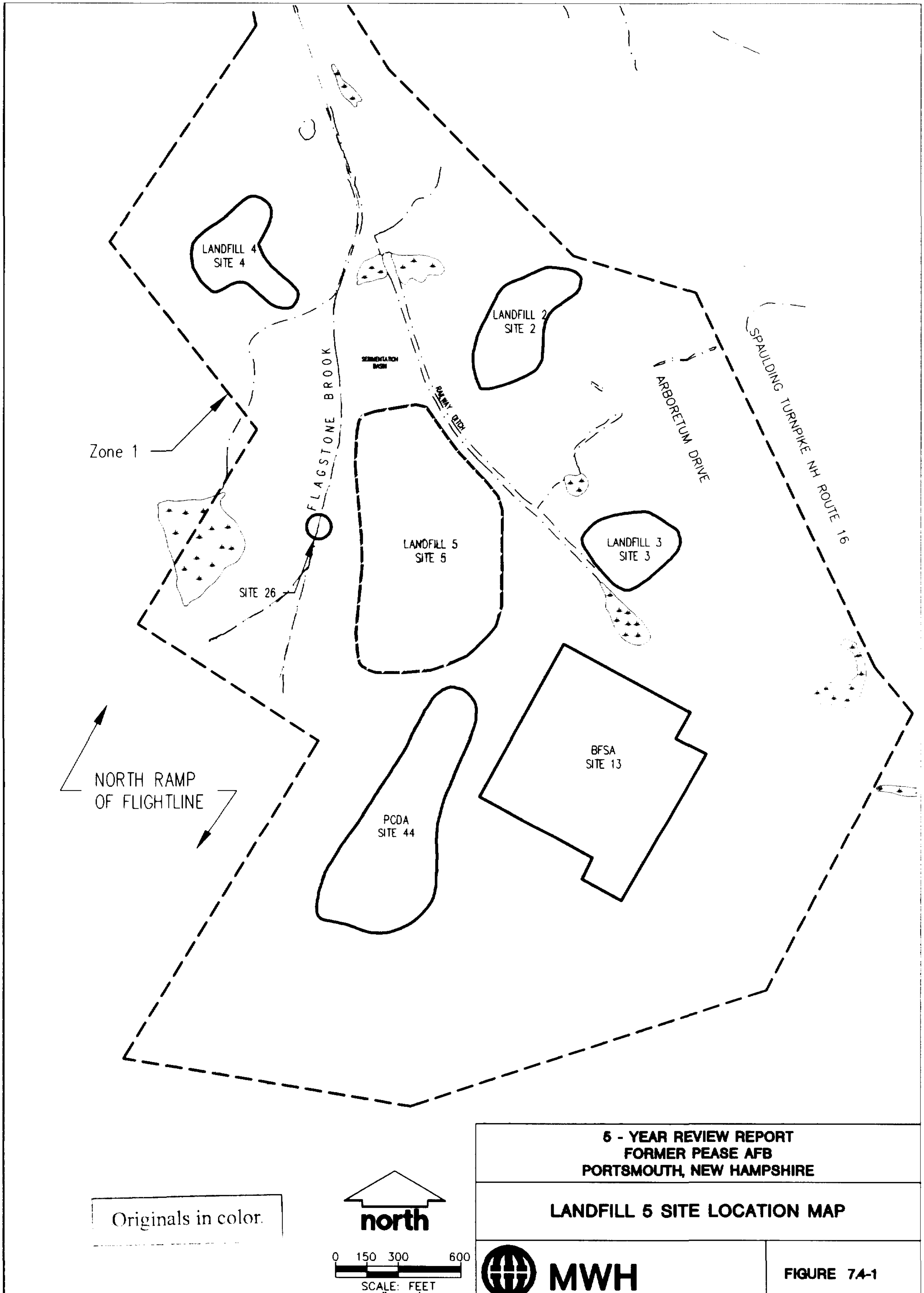

Originals in color.

5 - YEAR REVIEW REPORT
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LANDFILL 5 SITE LOCATION MAP

MWH

FIGURE 7.4-1

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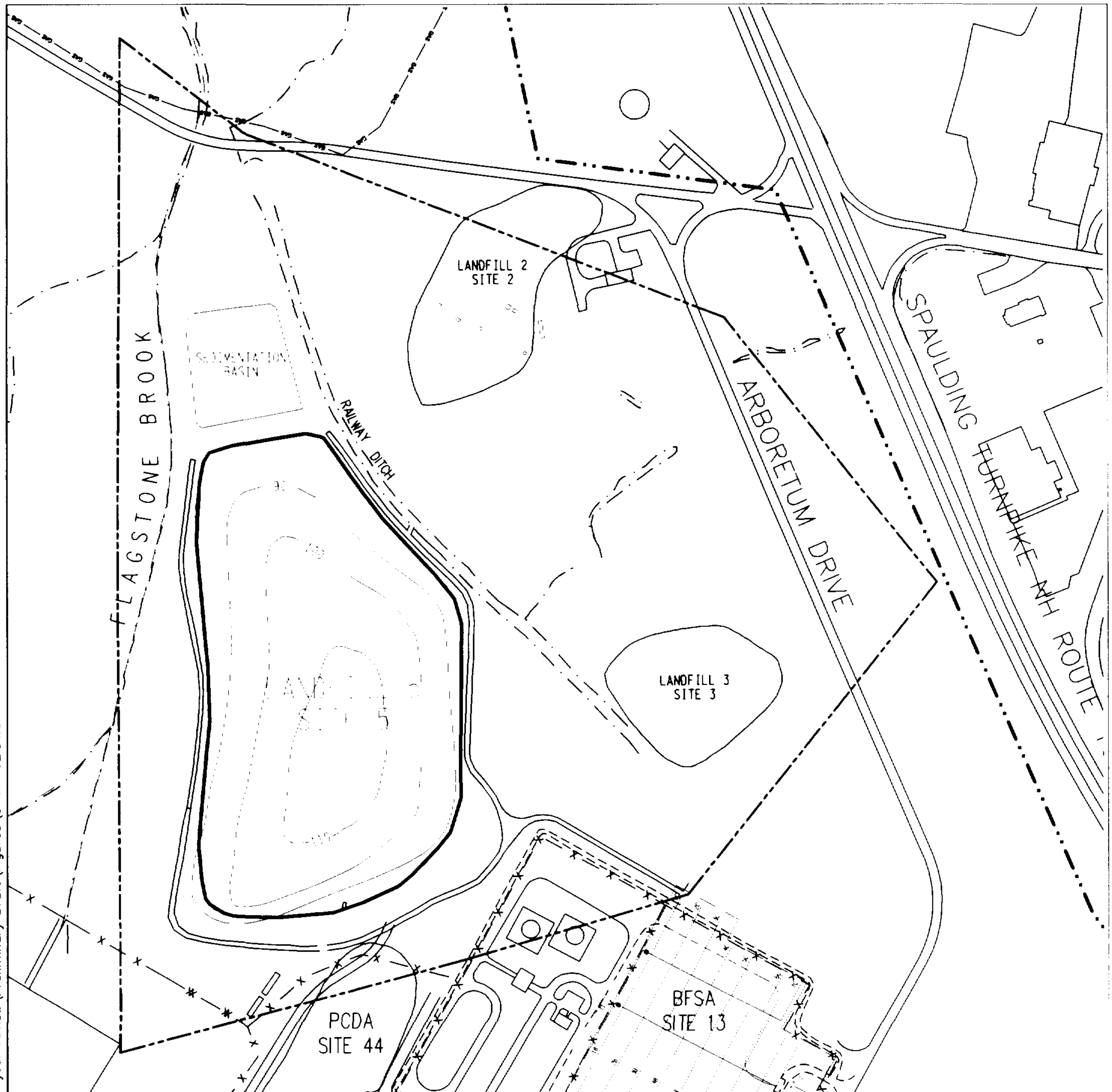


LEGEND

- GMZ BOUNDARY
- ACCESS ROAD
- TOPO CONTOUR
- EDGE OF WASTE/CAPPED AREA

north

0 175 350 500

SCALE: FEET
1"=500'

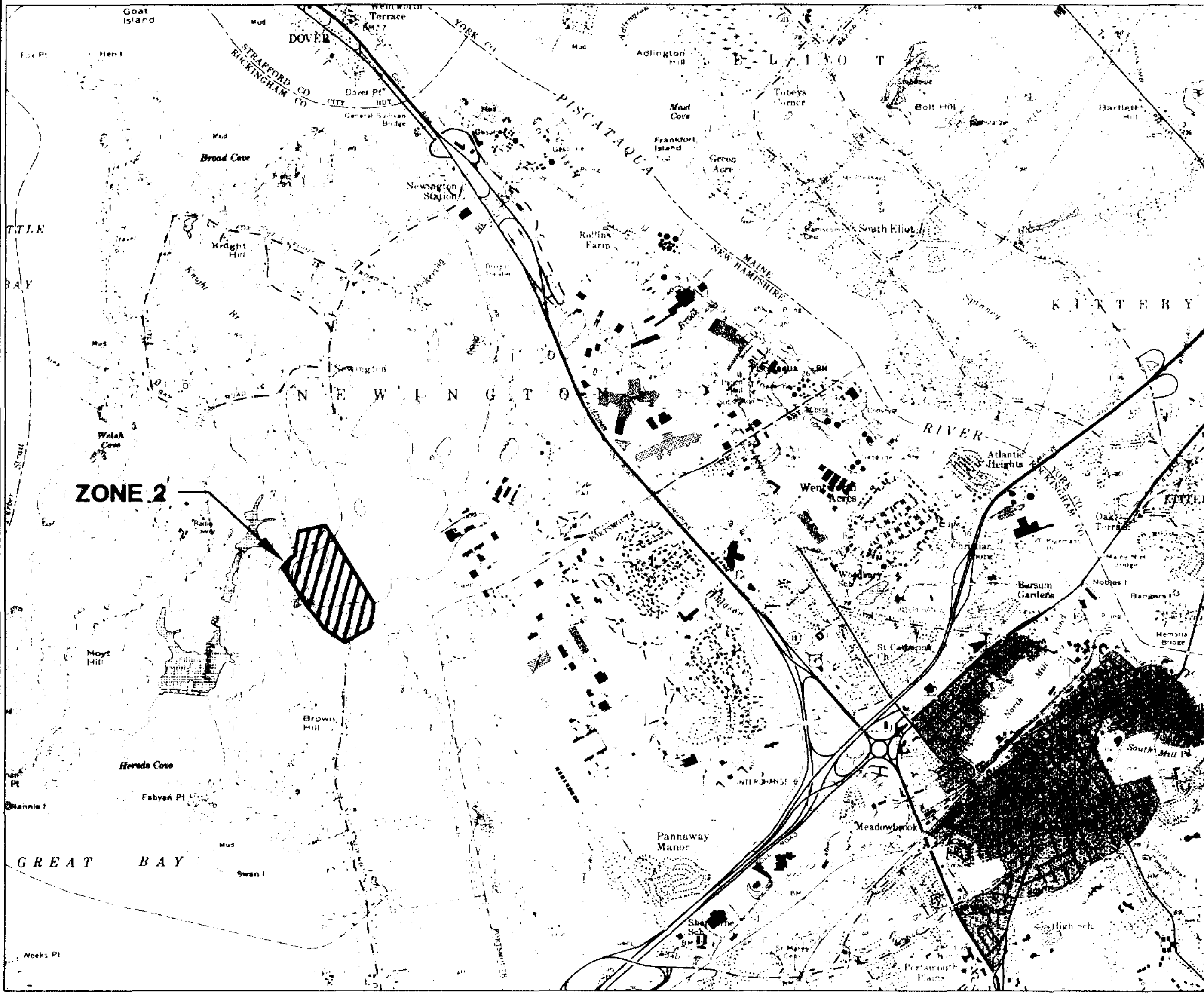
5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

LANDFILL 5 SITE FEATURES MAP

MWH

FIGURE 7.4-2

north



Source:
7.5 minute U.S.G.S. quadrangle of Portsmouth, NH–ME;
dated 1956 and revised 1993.

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SCALE: FEET
1"=4000' (APPROX)

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

ZONE 2 SITE LOCATION MAP

MWH

FIGURE 7.5-1

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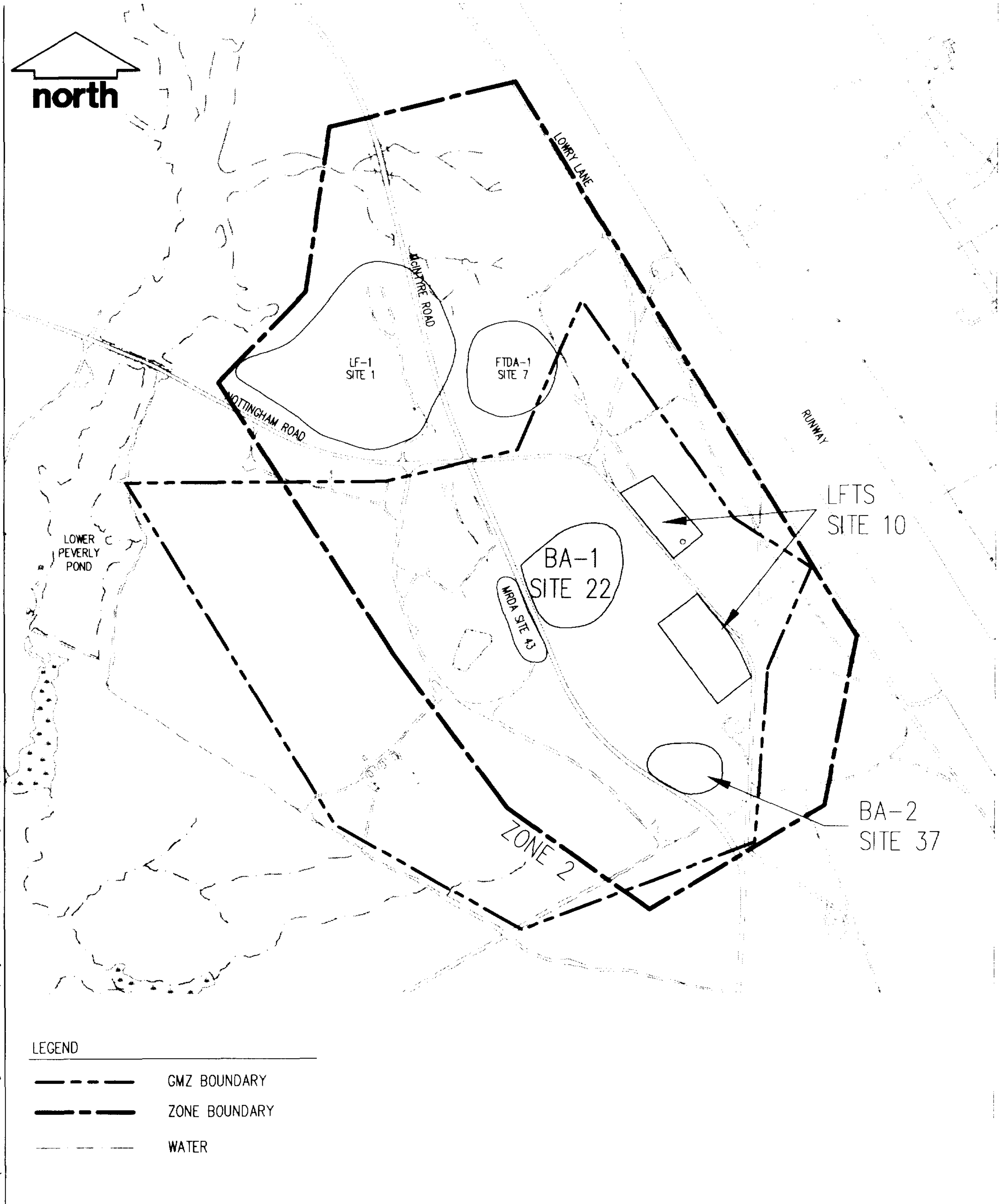

SOURCE: ZONE 2 2000 ANNUAL REPORT AND GROUNDWATER OPTIMIZATION EVALUATION (MW, 2001).

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

ZONE 2 SITE FEATURES MAP

MWH

FIGURE 7.5-2

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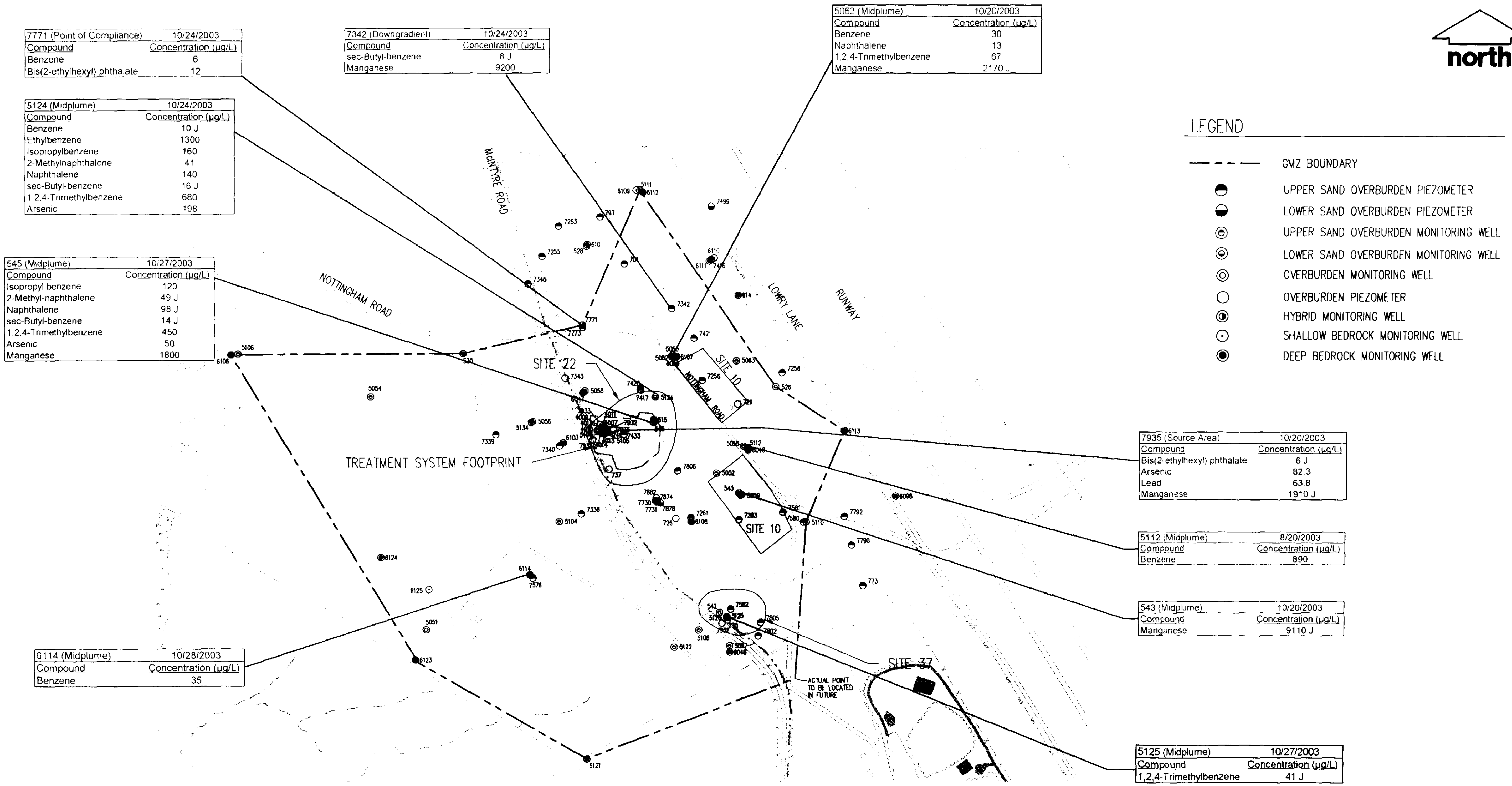

7771 (Point of Compliance)	10/24/2003
Compound	Concentration (µg/L)
Benzene	6
Bis(2-ethylhexyl) phthalate	12

5124 (Midplume)	10/24/2003
Compound	Concentration (µg/L)
Benzene	10 J
Ethylbenzene	1300
Isopropylbenzene	160
2-Methylnaphthalene	41
Naphthalene	140
sec-Butyl-benzene	16 J
1,2,4-Trimethylbenzene	680
Arsenic	198

545 (Midplume)	10/27/2003
Compound	Concentration (µg/L)
Isopropyl benzene	120
2-Methyl-naphthalene	49 J
Naphthalene	98 J
sec-Butyl-benzene	14 J
1,2,4-Trimethylbenzene	450
Arsenic	50
Manganese	1800

6114 (Midplume)	10/28/2003
Compound	Concentration (µg/L)
Benzene	35

7342 (Downgradient)	10/24/2003
Compound	Concentration (µg/L)
sec-Butyl-benzene	8 J
Manganese	9200

5062 (Midplume)	10/20/2003
Compound	Concentration (µg/L)
Benzene	30
Naphthalene	13
1,2,4-Trimethylbenzene	67
Manganese	2170 J

7935 (Source Area)	10/20/2003
Compound	Concentration (µg/L)
Bis(2-ethylhexyl) phthalate	6 J
Arsenic	82.3
Lead	63.8
Manganese	1910 J

5112 (Midplume)	8/20/2003
Compound	Concentration (µg/L)
Benzene	890

543 (Midplume)	10/20/2003
Compound	Concentration (µg/L)
Manganese	9110 J

5125 (Midplume)	10/27/2003
Compound	Concentration (µg/L)
1,2,4-Trimethylbenzene	41 J

SOURCE:
ZONE 2 2000 ANNUAL REPORT AND GROUNDWATER OPTIMIZATION EVALUATION (MW, 2001).

0 125 250 500
SCALE: FEET
1"=500'

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

ZONE 2 GROUNDWATER VOC & SVOC CONTAMINANTS EXCEEDING CGs IN 2003

MWH

FIGURE 7.5-3

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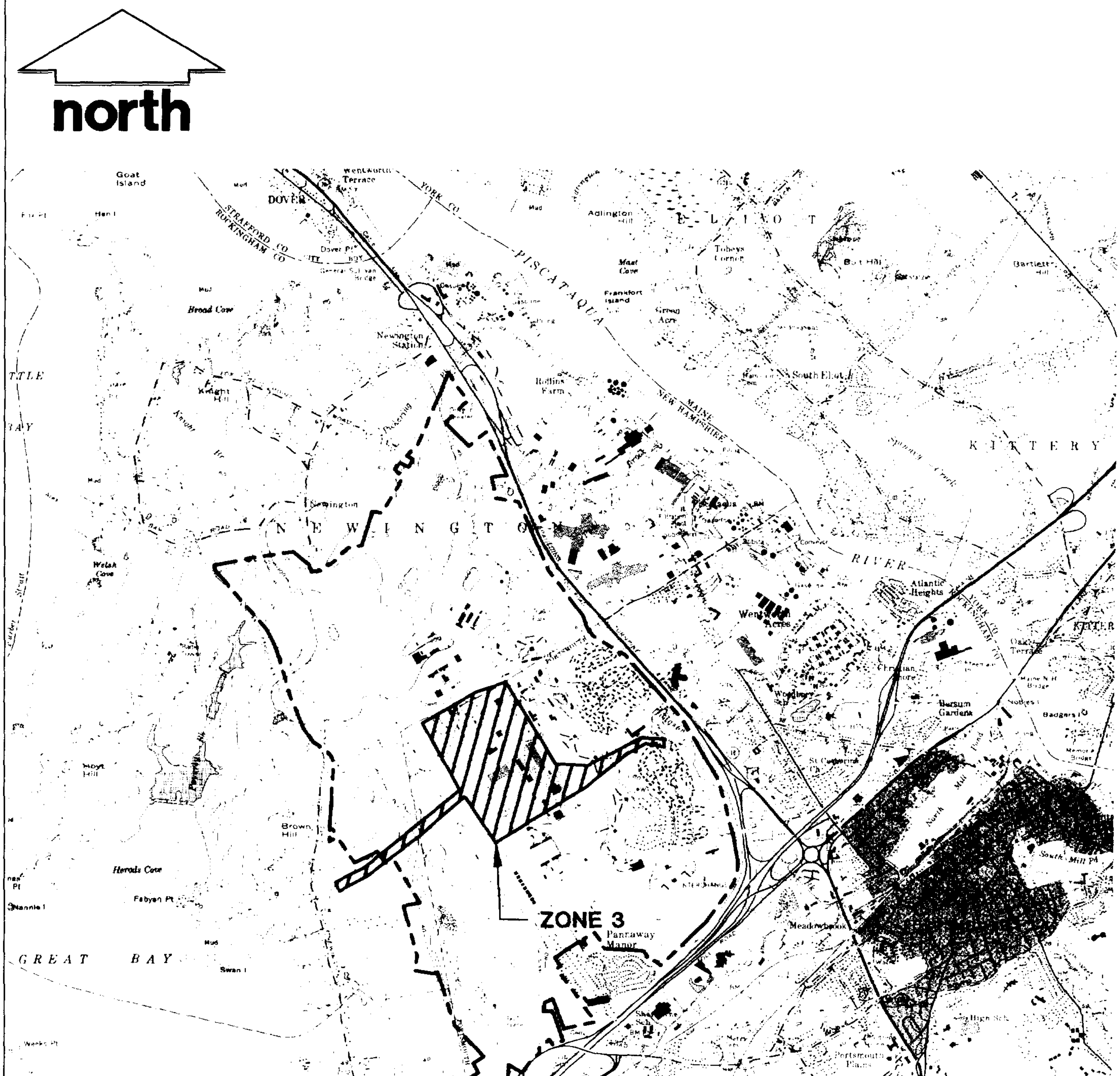

LEGEND

FORMER BASE BOUNDARY

Source:
7.5 minute U.S.G.S. quadrangle of Portsmouth, NH–ME; dated 1956 and revised 1993.

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SCALE: FEET
1"=4000' (APPROX)

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

ZONE 3 SITE LOCATION MAP

MWH

FIGURE 7.6-1

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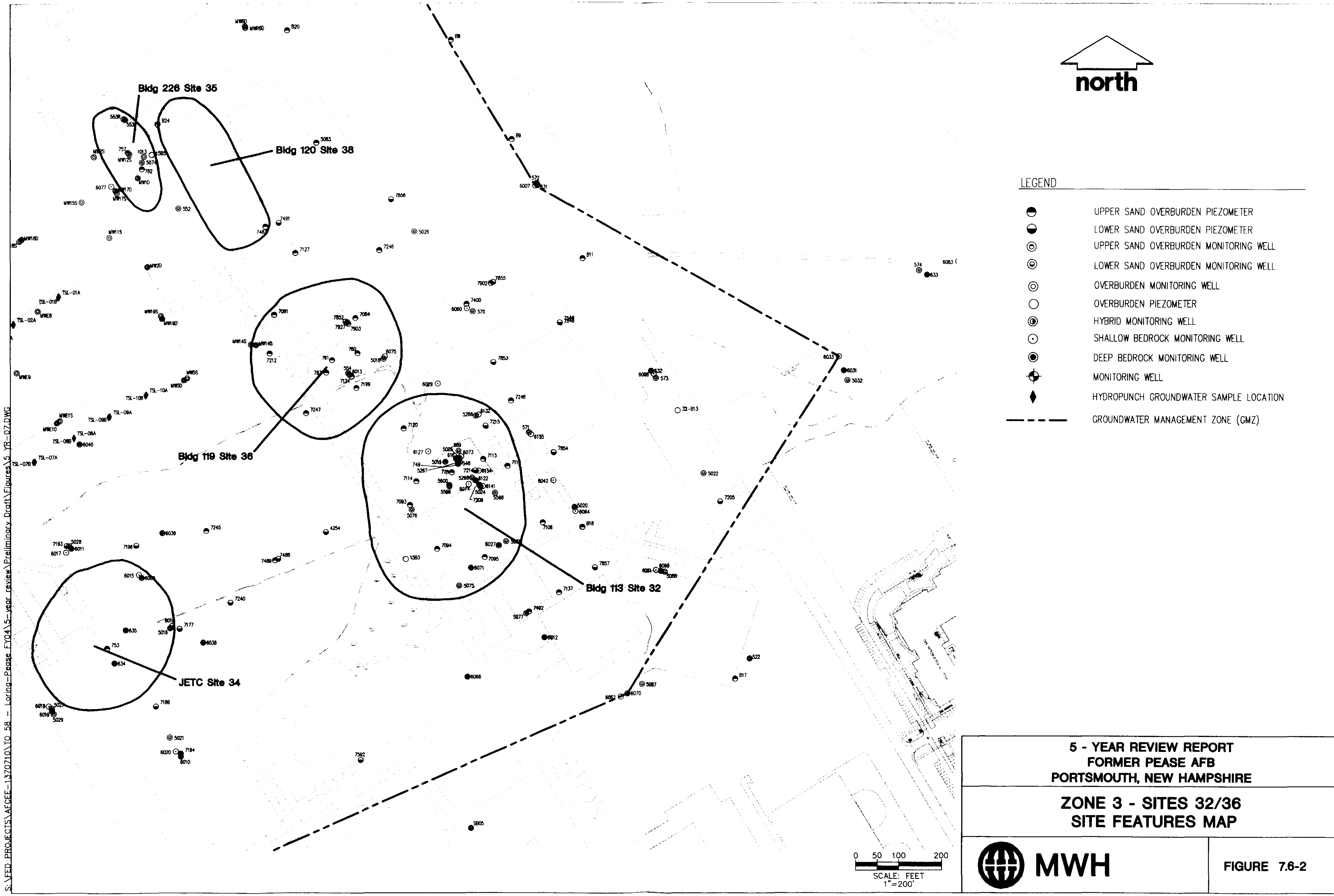

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

ZONE 3 - SITES 32/36
SITE FEATURES MAP

MWH

FIGURE 7.6-2

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DOC ID: 65334

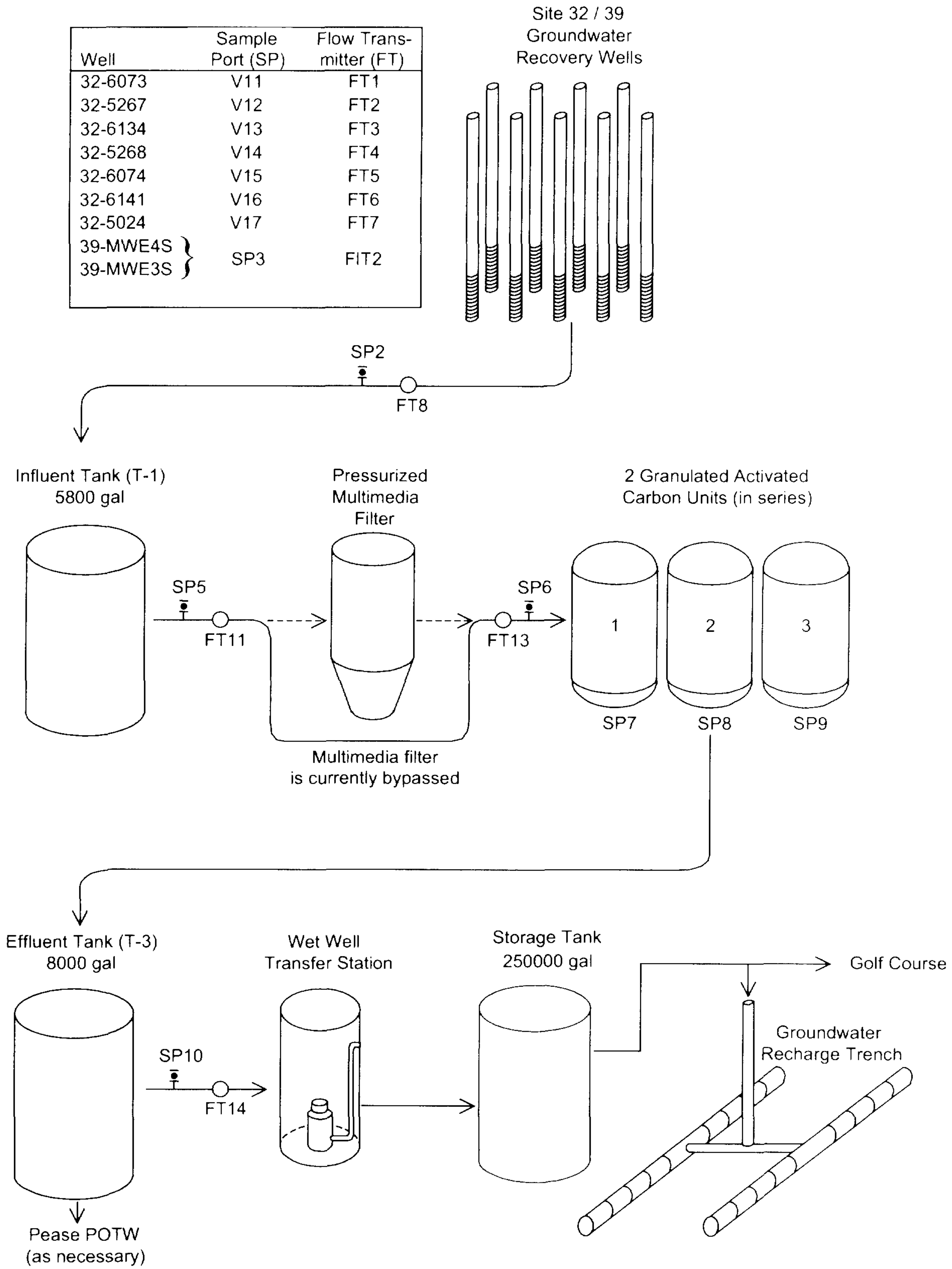
DATE: September, 2004

TITLE: GROUNDWATER CONCENTRATIONS EXCEEDING ZONE 3 CLEAN UP GOALS

DESCRIPTION: FORMER PEASE AIR FORCE BASE, 5 YEAR REVIEW REPORT

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

Well	Sample Port (SP)	Flow Transmitter (FT)
32-6073	V11	FT1
32-5267	V12	FT2
32-6134	V13	FT3
32-5268	V14	FT4
32-6074	V15	FT5
32-6141	V16	FT6
32-5024	V17	FT7
39-MWE4S, 39-MWE3S	SP3	FIT2



Source: *Bechtel Zone 3 2000 Annual Report*

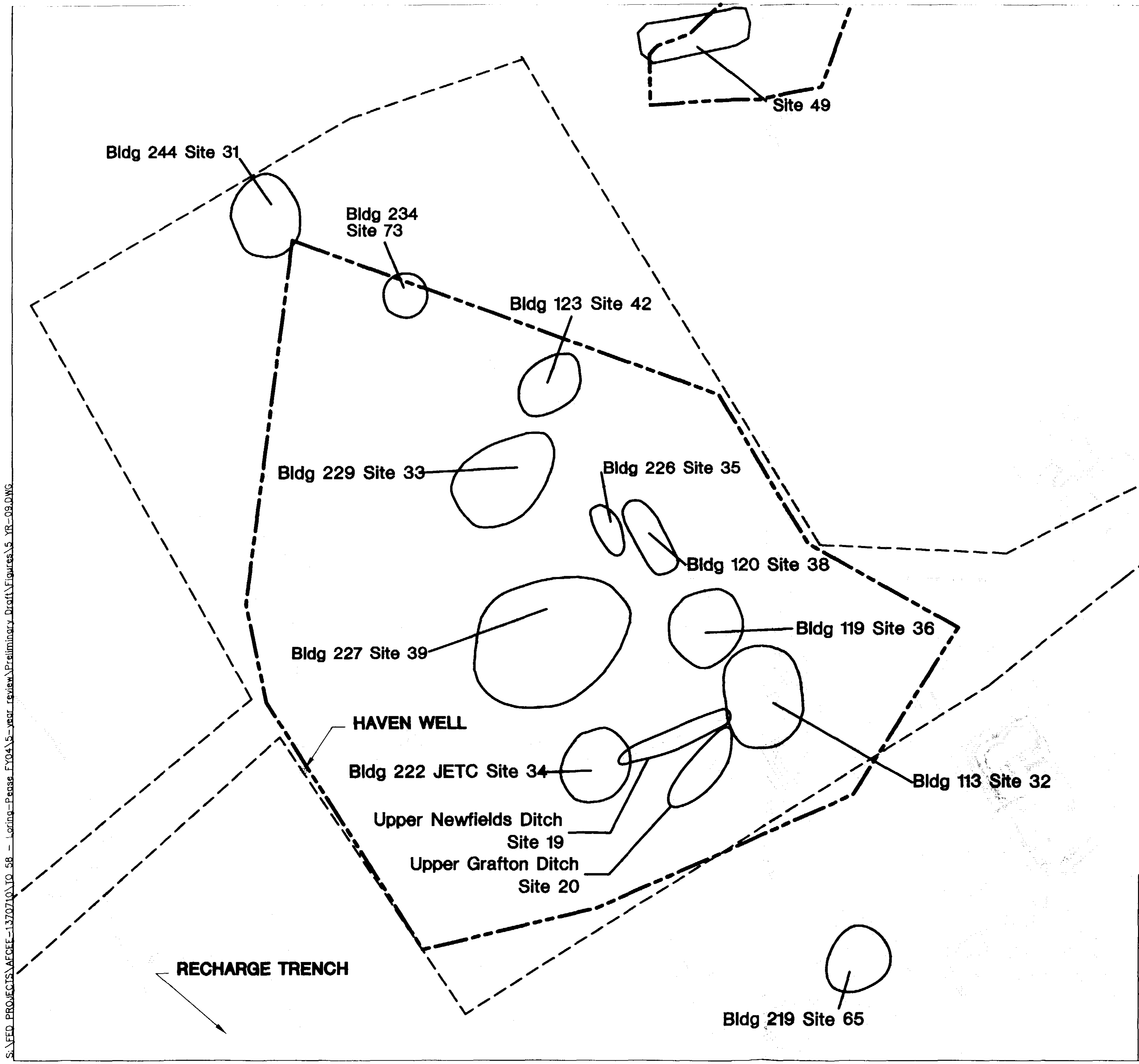
5 YEAR REVIEW REPORT
FORMER PEASE AFB, PORTSMOUTH, NH

SITE 32 TREATMENT SYSTEM PROCESS FLOW DIAGRAM

MWH

FIGURE 7.6-4

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-09.DWG



LEGEND

- ZONE 3 BOUNDARY
- APPROXIMATE SITE LOCATION
- GROUNDWATER MANAGEMENT ZONE (GMZ)
- FENCE
- ROAD
- MARSH AREA
- NATURAL GAS LINE
- DRAINAGE DITCH/STREAM
- STORM DRAINAGE SYSTEM
- FLIGHTLINE REFUELING SYSTEM. SINGLE JP-4 LATERALS AND HYDRANTS
- FIRE HYDRANT

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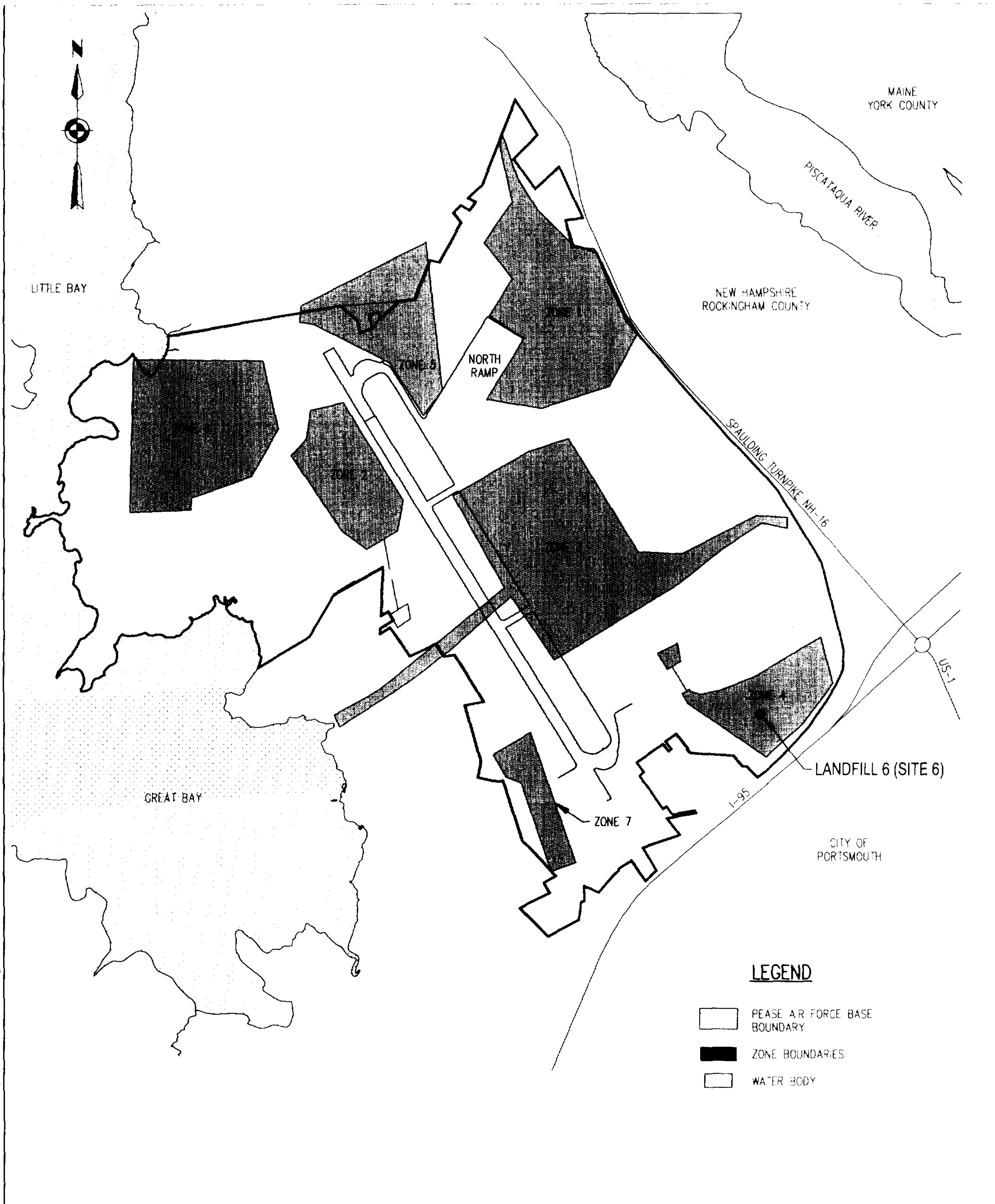
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

ZONE 3 - SITES 34/39
SITE FEATURES MAP

MWH

FIGURE 7.7-1



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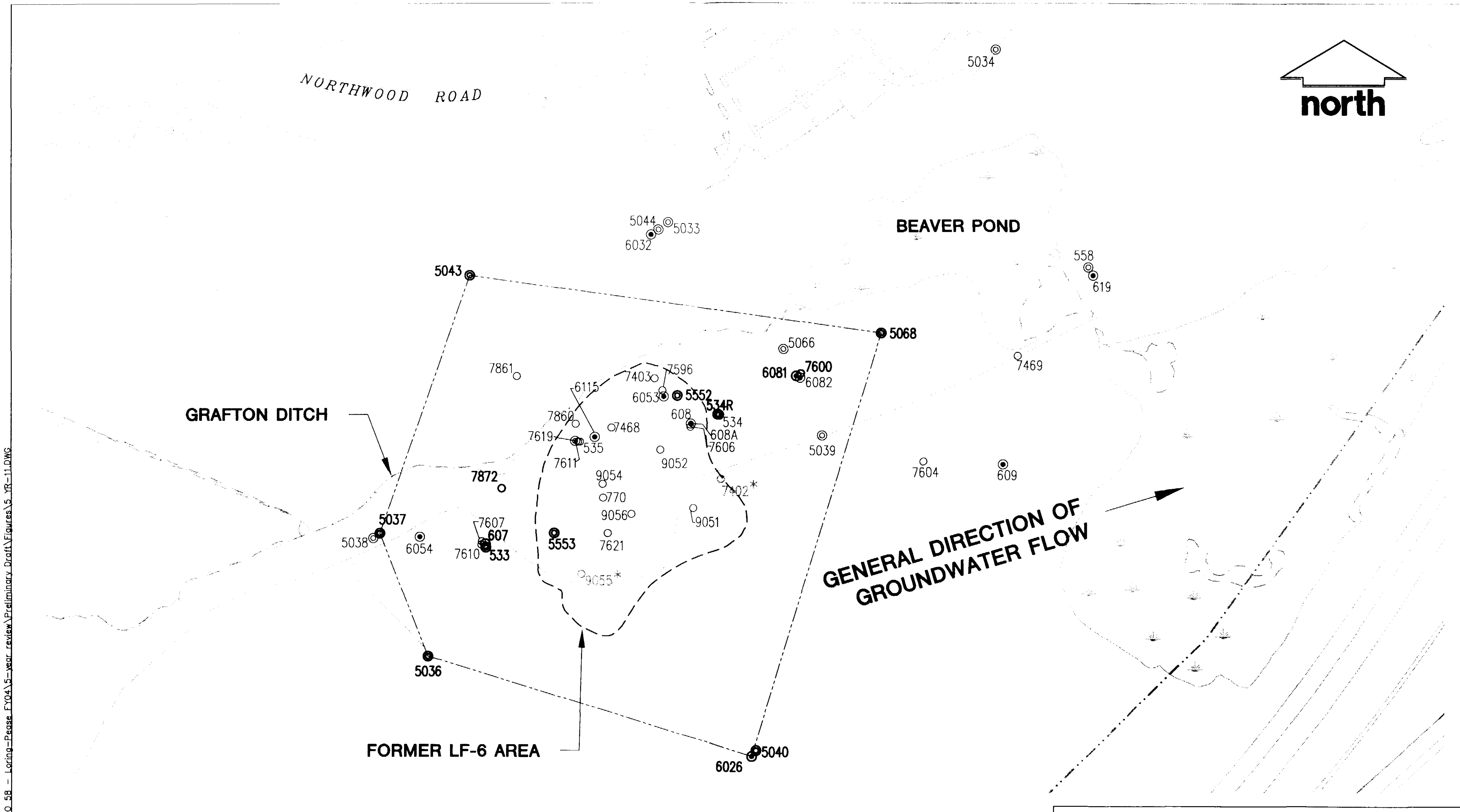
LANDFILL 6 SITE LOCATION MAP

MWH

FIGURE 7.8-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-10.DWG

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-11.DWG



NOTES:

1. WELLS IN BOLD ARE INCLUDED IN THE LANDFILL 6 LONG TERM MONITORING PLAN, REV. 1 (BECHTEL, 2000).
2. * - DELETED FROM LTMP IN JULY 2003. WELL 7402 HAS BEEN ABANDONED. WELL 9055 IS SUBMERGED AND IS INACCESSIBLE.

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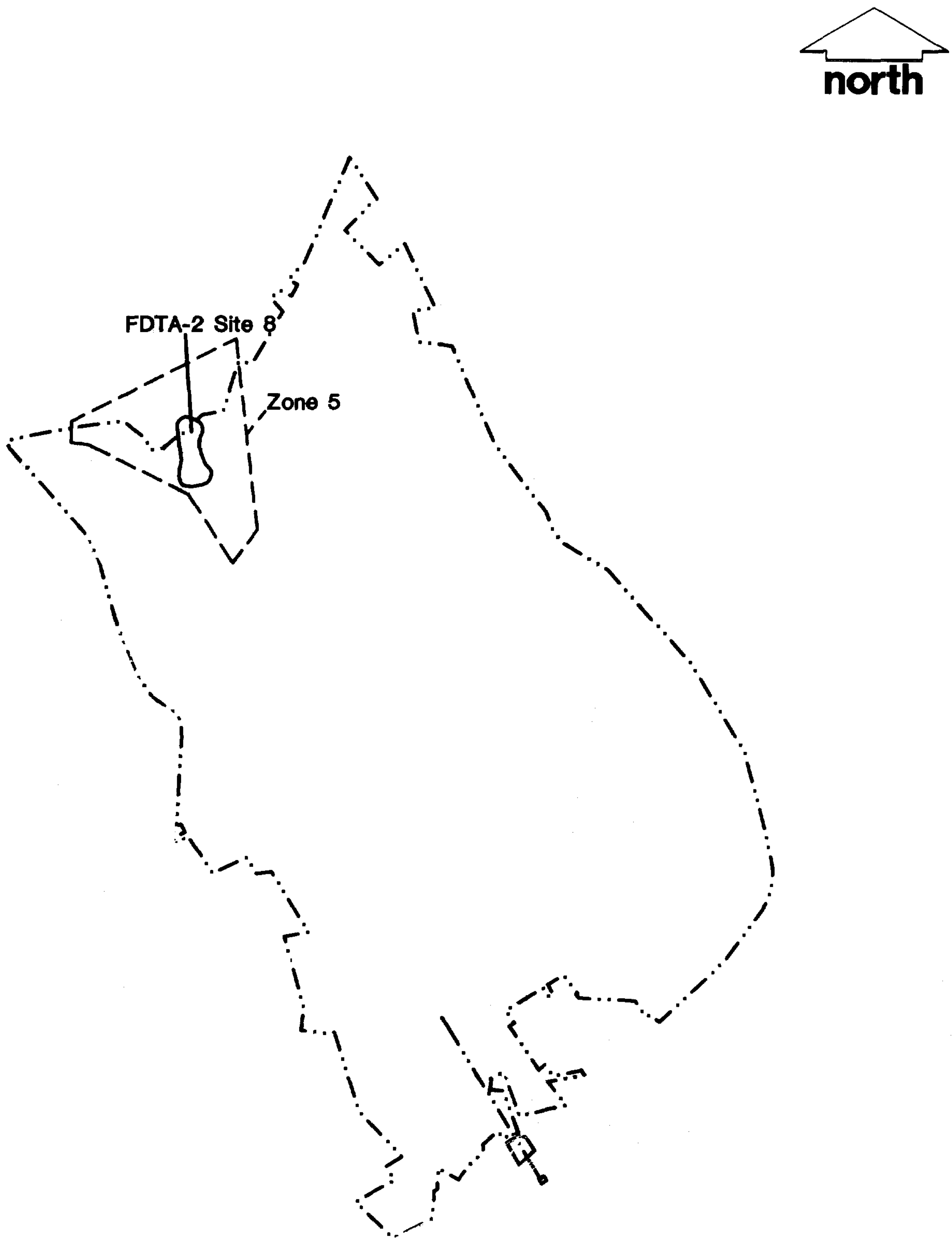
LANDFILL 6 SITE FEATURES MAP

MWH

FIGURE 7.8-2



0 750 1500 3000
SCALE: FEET
1"=3,000'

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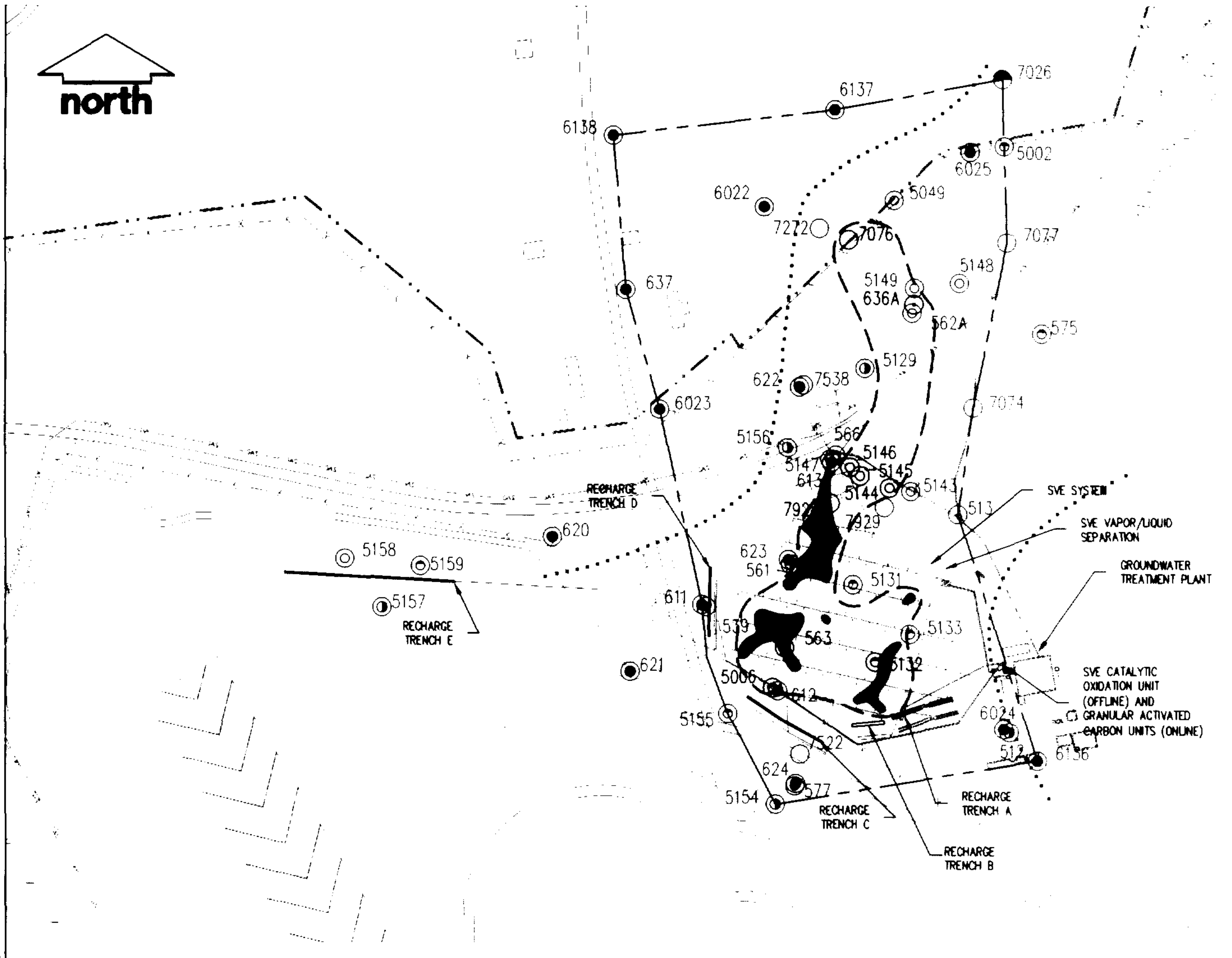
SITE 8 SITE LOCATION MAP

MWH

FIGURE 7.9-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-12.DWG



LEGEND

- LOWER SAND OVERBURDEN MONITORING WELL
- UPPER SAND OVERBURDEN MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL
- HYBRID MONITORING WELL
- LOWER SAND OVERBURDEN PIEZOMETER
- UPPER SAND OVERBURDEN PIEZOMETER
- OVERBURDEN PIEZOMETER
- OVERBURDEN MONITORING WELL
- MONITORING WELL
- FENCE
- ROAD
- DRAINAGE DITCH/STREAM
- EDGE OF SATURATED OVERBURDEN
- GMZ BOUNDARY
- FREE PRODUCT (2003)
- APPROXIMATE EXTENT OF GROUNDWATER PLUME (2003)
- WELL BELOW CRITERION IN MOST RECENT SAMPLE
- WELL ABOVE CRITERION IN MOST RECENT SAMPLE

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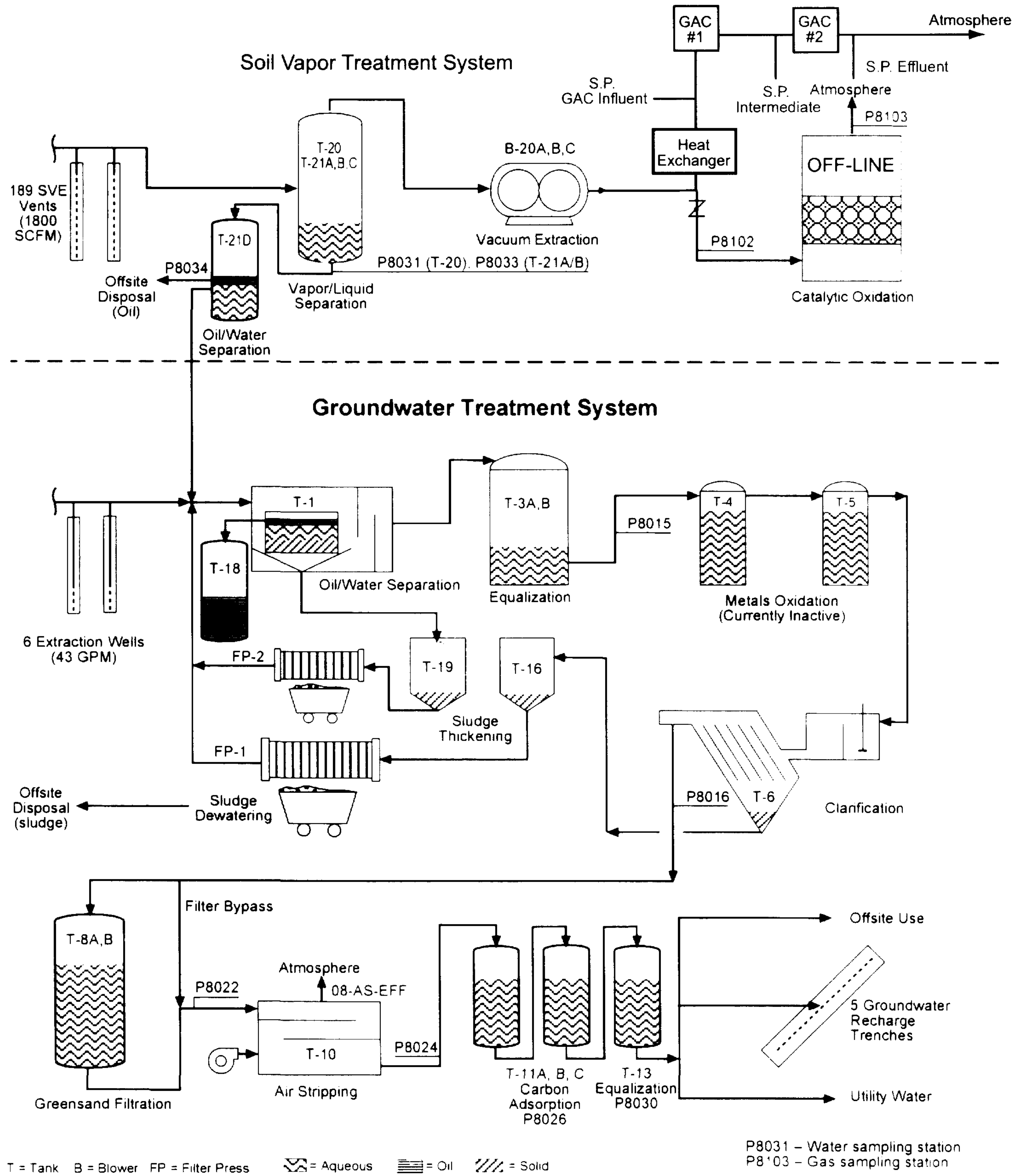
SITE 8 SITE FEATURES MAP

MWH

FIGURE 7.9-2

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-13.DWG



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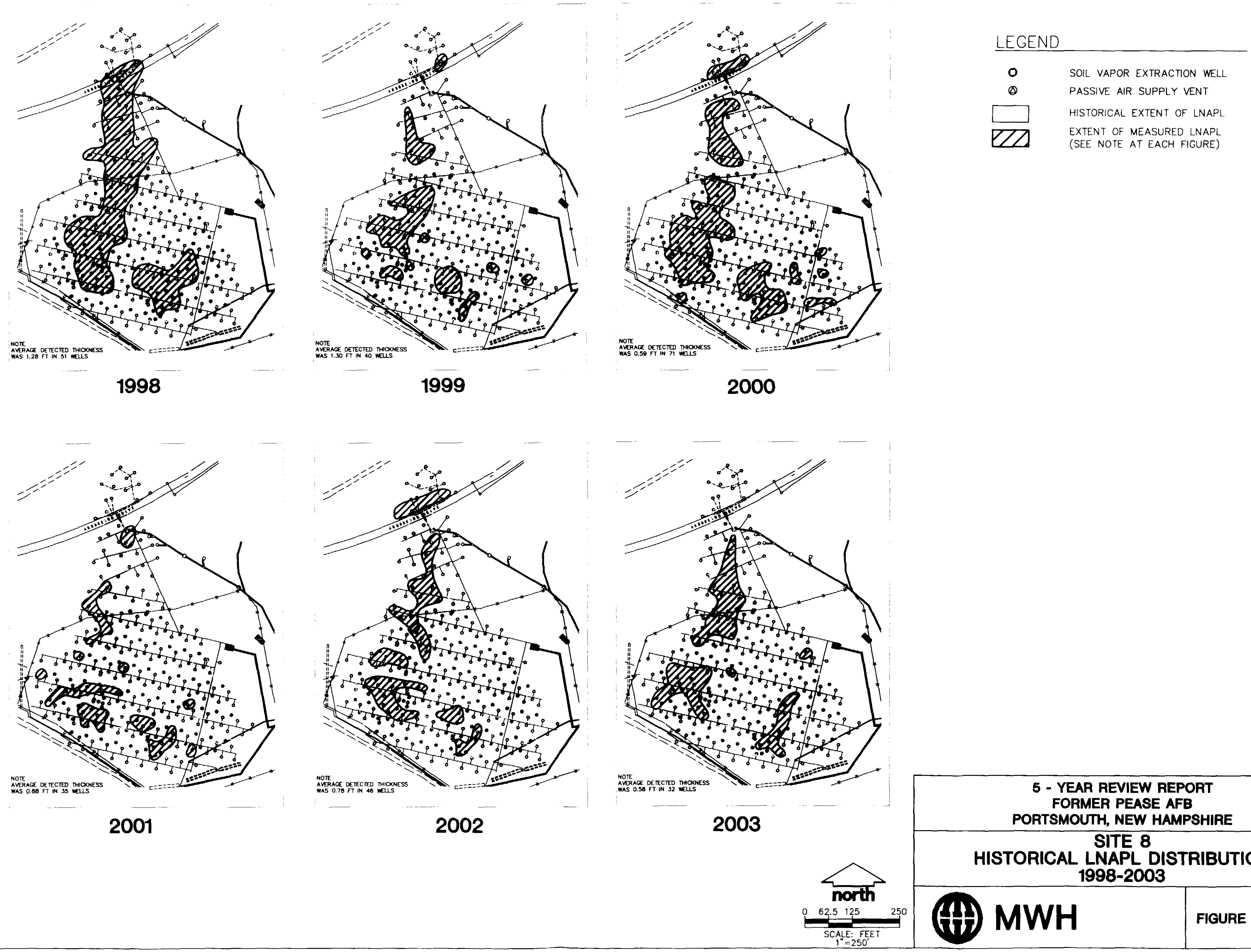
FORMER PEASE AFB, PORTSMOUTH, NH

Site 8 Process Flow and Sampling Locations

MWH MONTGOMERY WATSON HARZA

FIGURE 7.9-3



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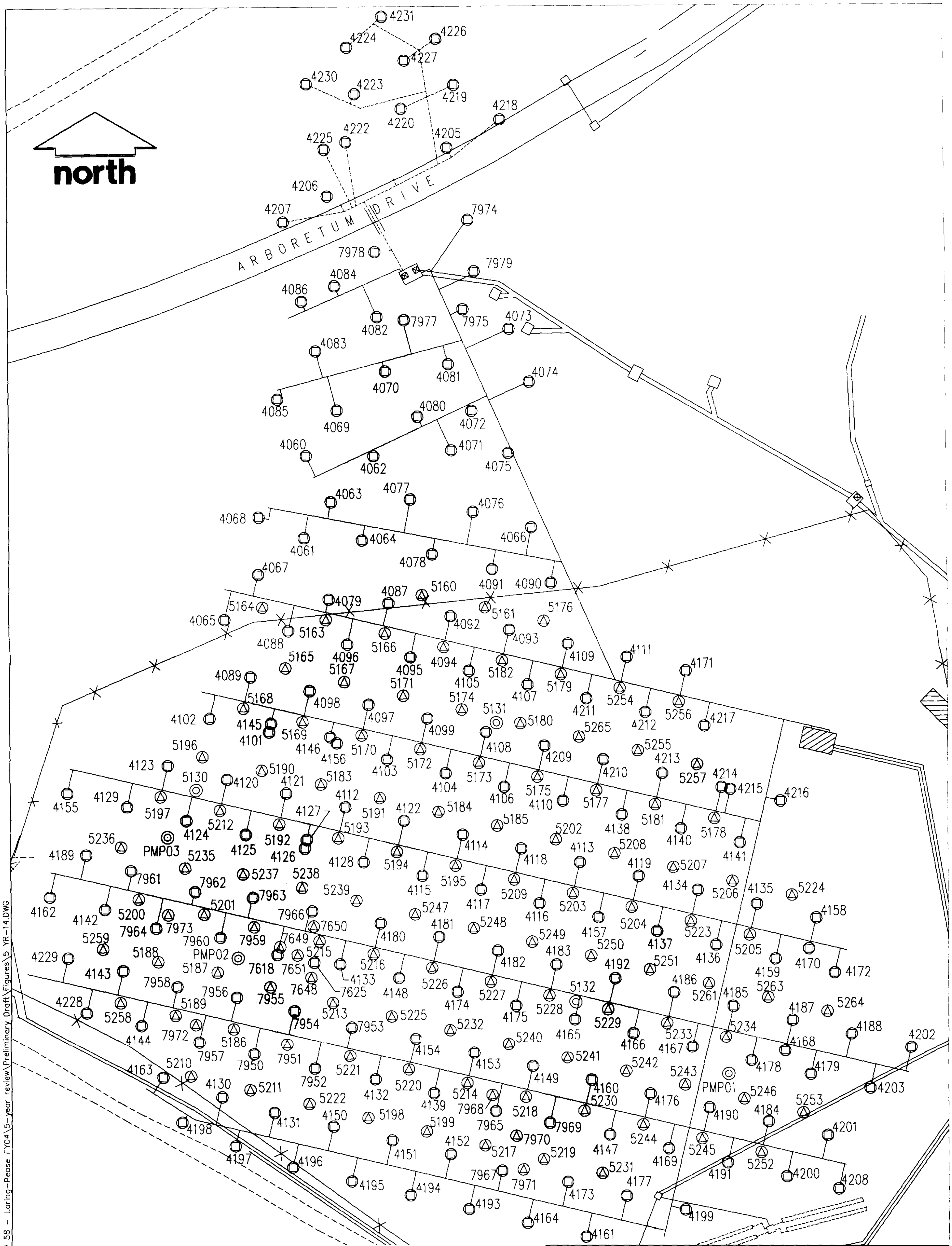
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

SITE 8
HISTORICAL LNAPL DISTRIBUTION
1998-2003

MWH

FIGURE 7.9-4



LEGEND

- SOIL VAPOR EXTRACTION WELL
- PASSIVE AIR SUPPLY VENT

LNAPL DETECTED AT LEAST ONCE IN 2003

0 15 30 60
SCALE: FEET
1"=60'

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SITE 8
SVE SYSTEM WELL CONFIGURATION

MWH

FIGURE 7.9-5

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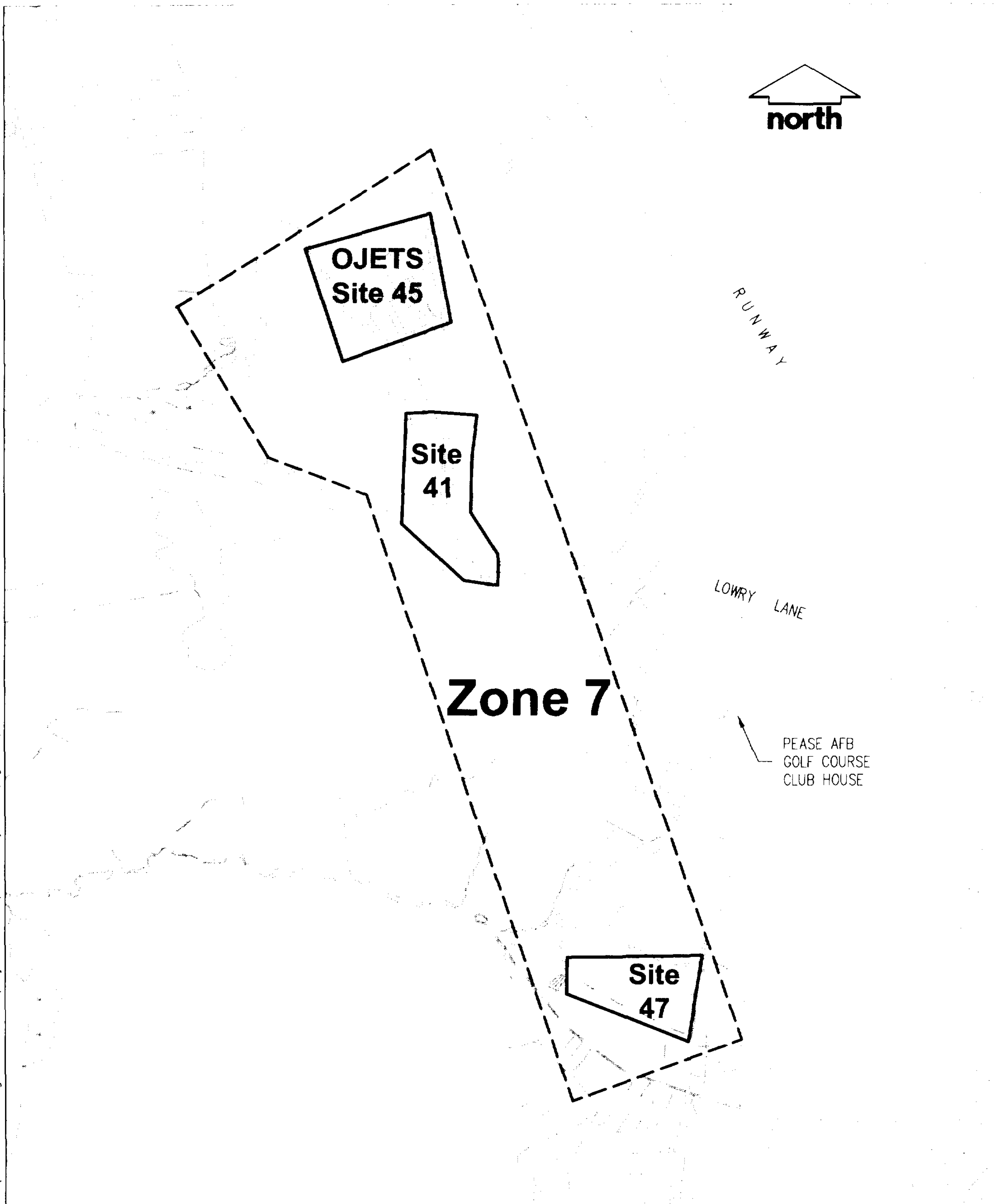

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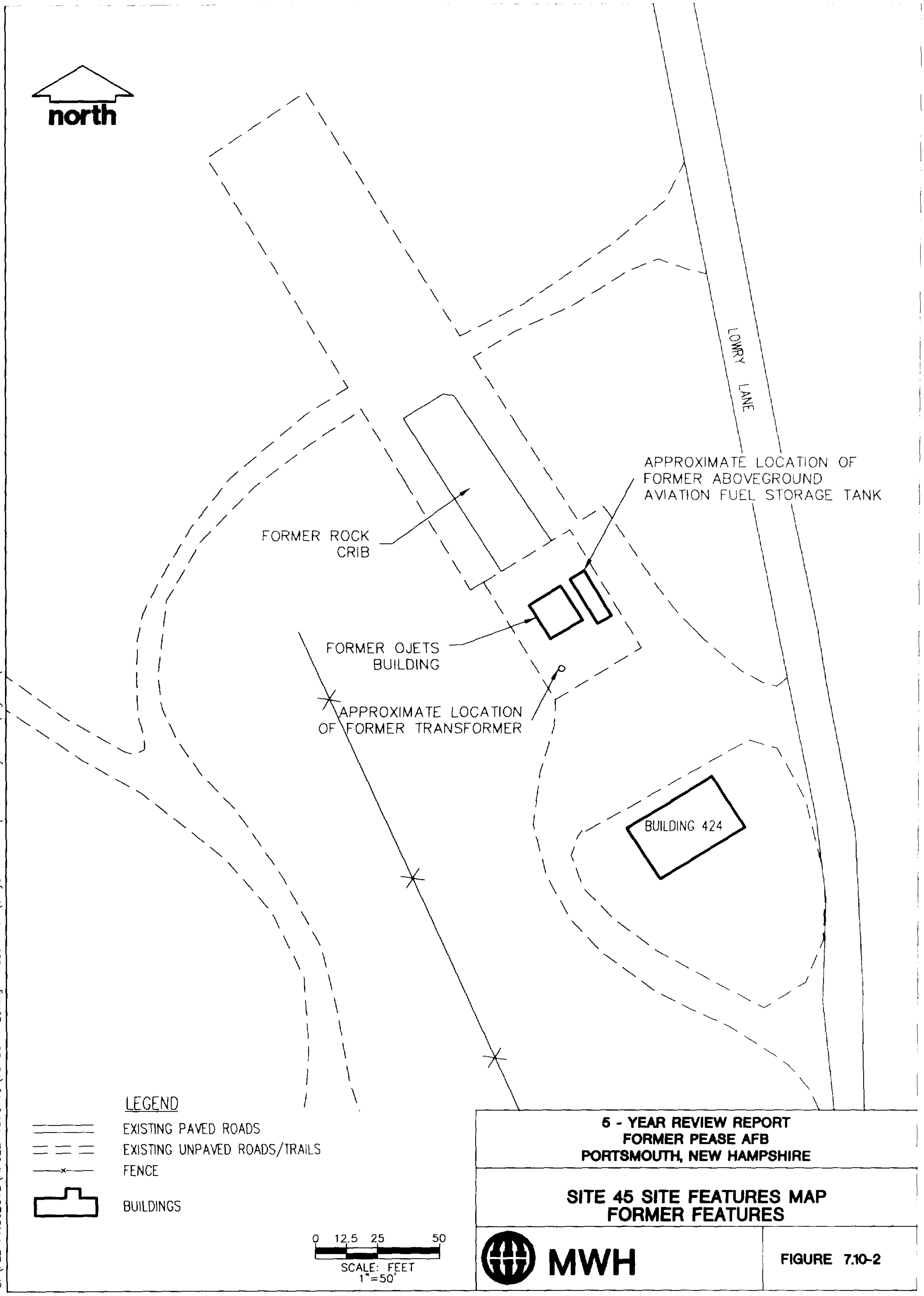
SITE 45 SITE LOCATION MAP

MWH

FIGURE 7.10-1



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FORMER PEASE AFB
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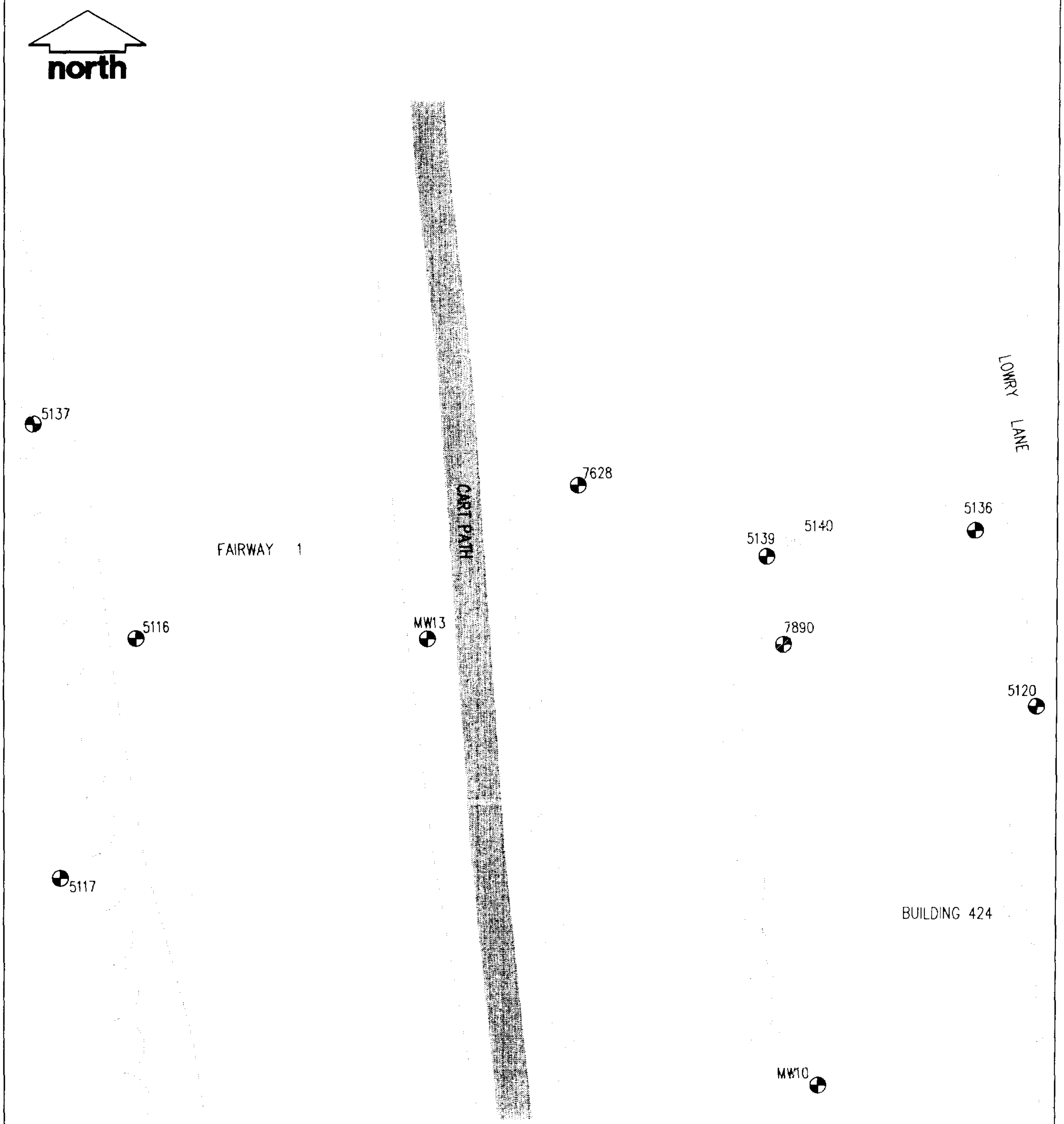
SITE 45 SITE FEATURES MAP
FORMER FEATURES

MWH

FIGURE 7.10-2



LEGEND

EXISTING PAVED ROADS

FENCE

SHALLOW UPPER SAND WELL

DEEP UPPER SAND WELL

TREELINE

0 12.5 25 50
SCALE: FEET
1"=50'

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SITE 45 SITE FEATURES MAP
NINE HOLE GOLF COURSE ADDITION

MWH

FIGURE 7.10-3

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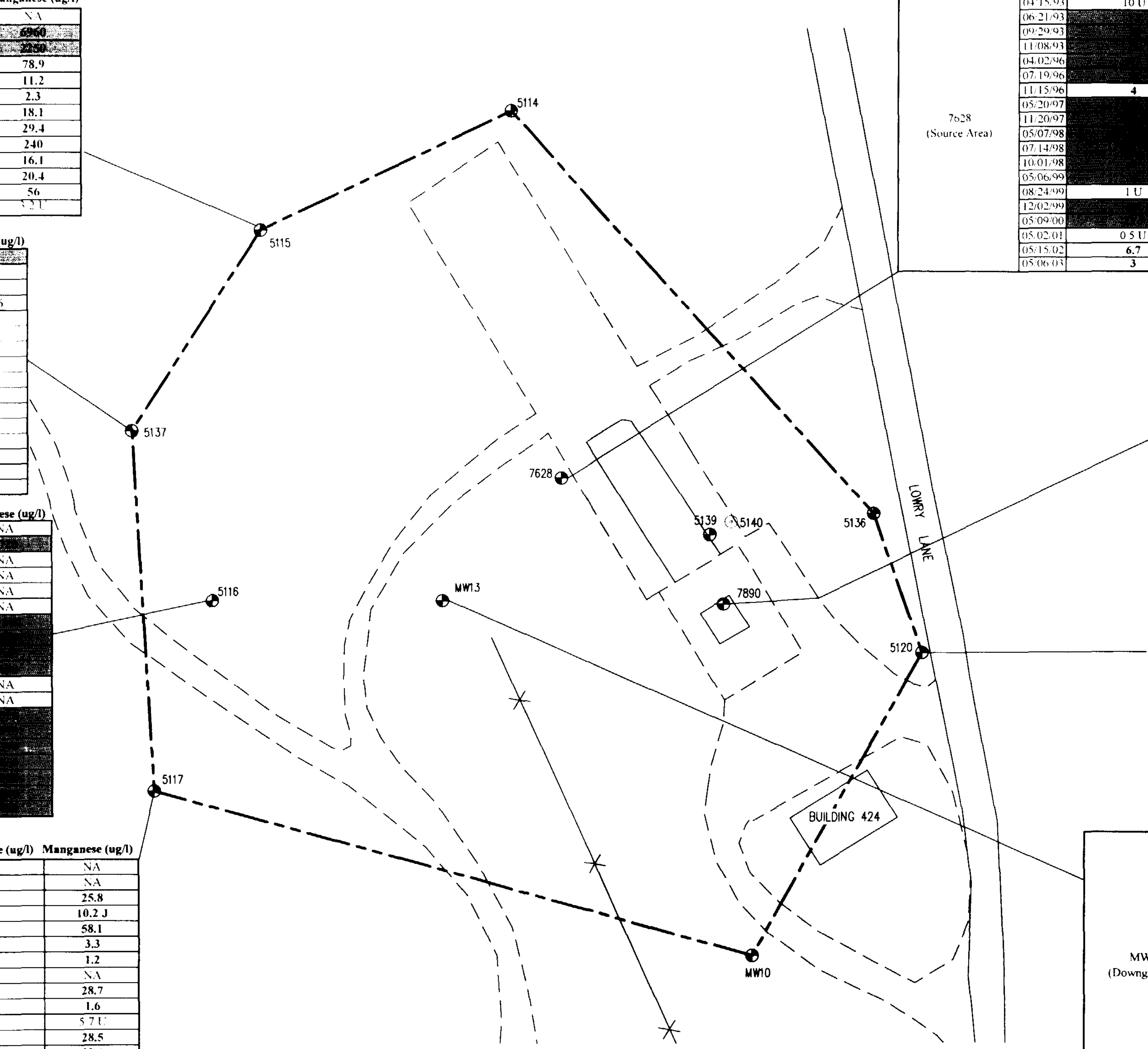
S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-19.DWG



5115 (GMZ Boundary)

Date	Sec-butylbenzene (ug/l)	Manganese (ug/l)
05/07/93	1 U	NA
06/22/93	1 U	6960
11/13/96	0.5 U	2250
05/20/97	0.5 U	78.9
11/19/97	0.5 U	11.2
05/05/98	1 U	2.3
11/02/98	1 U	18.1
05/05/99	1 U	29.4
12/01/99	2 U	240
05/04/00	1 U	16.1
05/02/01	0.5 U	20.4
05/15/02	1 U	56
05/06/03	0.5 U	3.2 U

5137 (Downgradient GMZ Boundary)

Date	Sec-butylbenzene (ug/l)	Manganese (ug/l)
09/29/93	1 U	9790 J
04/01/96	1 U	NA
07/18/96	U	1.8 J
11/14/96	0.5 U	166, 166
05/19/97	0.5 U	134
11/20/97	0.5 U	13.4
05/06/98	1 U	5.8
07/13/98	1 UJ	NA
11/03/98	1 U	4
05/05/99	1 U	79.4
08/18/99	1 U	73.5
12/06/99	2 U	2 U
05/04/00	1 U	20.2
05/01/01	0.5 U	22.8
05/15/02	1 U	6.6
05/06/03	0.5 U	1.8 U

5116 (Downgradient)

Date	Sec-butylbenzene (ug/l)	Manganese (ug/l)
05/07/93	2	NA
06/22/93	3 J	[illegible]
09/29/93	4	NA
11/08/93	2	NA
04/22/94	3	NA
04/01/96	1 U	NA
07/18/96	7	[illegible]
11/14/96	1 J	[illegible]
05/21/97	4	[illegible]
05/07/98	1	[illegible]
07/13/98	3	NA
09/30/98	1 J	NA
05/05/99	1	[illegible]
08/18/99	0.8 J	[illegible]
12/02/99	2 U	[illegible]
05/08/00	3	[illegible]
05/01/01	1	[illegible]
05/15/02	NA	[illegible]
05/06/03	NA	[illegible]

5117 (Downgradient GMZ Boundary)

Date	Sec-butylbenzene (ug/l)	Manganese (ug/l)
05/07/93	1 U	NA
04/01/96	1 U	NA
07/18/96	2 J	25.8
11/14/96	0.5 U	10.2 J
05/19/97	0.5 U	58.1
11/20/97	0.5 UJ	3.3
05/06/98	1 U	1.2
07/13/98	1 U	NA
11/02/98	1 U	28.7
05/05/99	1 U	1.6
08/18/99	0.5 J	5.7 U
12/06/99	2 U	28.5
05/08/00	1 U	32.6
05/01/01	0.5 U	50 U
05/15/02	1 U	3.4 U
05/06/03	0.5 U	7.2 U

7628 (Source Area)

Date	Sec-butylbenzene (ug/l)	Manganese (ug/l)
01/11/93	[illegible]	[illegible]
04/15/93	10 U	NA
06/21/93	[illegible]	[illegible]
09/29/93	[illegible]	NA
11/08/93	[illegible]	NA
04/02/96	[illegible]	NA
07/19/96	[illegible]	[illegible]
11/15/96	4	[illegible]
05/20/97	[illegible]	[illegible]
11/20/97	[illegible]	NA
05/07/98	[illegible]	[illegible]
07/14/98	[illegible]	NA
10/01/98	[illegible]	NA
05/06/99	[illegible]	[illegible]
08/24/99	1 U	[illegible]
12/02/99	[illegible]	[illegible]
05/09/00	[illegible]	[illegible]
05/02/01	0.5 U	[illegible]
05/15/02	6.7	[illegible]
05/06/03	3	[illegible]

7890 (Source Area)

Date	Sec-butylbenzene (ug/l)	Manganese (ug/l)
07/27/93	200 U	NA
09/29/93	50 U	[illegible]
11/08/93	[illegible]	NA
09/06/94	[illegible]	NA
09/28/94	[illegible]	NA
10/31/94	5 J	NA
12/12/94	7 J	NA
04/02/96	5	NA
07/19/96	6 J	[illegible]
11/15/96	2	[illegible]
05/20/97	3	[illegible]
11/20/97	6 J	NA
05/08/98	[illegible]	[illegible]
07/14/98	[illegible]	NA
10/05/98	[illegible]	NA
05/06/99	2	[illegible]
08/24/99	1 U	[illegible]
12/02/99	3	[illegible]
05/10/00	4 J	[illegible]
05/02/01	7 J	[illegible]
05/15/02	5	[illegible]
05/06/03	7 J	[illegible]

5120 (GMZ Boundary)

Date	Sec-butylbenzene (ug/l)	Manganese (ug/l)
06/25/93	1 U	NA
09/29/93	1 U	975 J
11/14/96	0.5 U	9.1 U
11/15/96	NA	NA
05/20/97	0.5 U	5.3 J
11/19/97	0.5 UJ	0.73 U
05/04/98	1 U, 1 U	0.85 U
11/03/98	1 U	0.77 U
05/05/99	1 U	34.7
12/01/99	2 U	0.4 U
05/10/00	1 U	20.7
05/01/01	0.5 U	18.2
05/15/02	1 U	22.3
05/06/03	0.5 U	129

MW13 (Downgradient)

Date	Sec-butylbenzene (ug/l)	Manganese (ug/l)
01/11/93	[illegible]	[illegible]
04/15/93	3	NA
06/22/93	2 J	[illegible]
09/30/93	4	NA
11/08/93	2	NA
07/19/96	5	[illegible]
11/15/96	1	[illegible]
05/21/97	3	[illegible]
05/07/98	3	[illegible]
07/13/98	2	NA
09/30/98	0.8 UJ	NA
05/06/99	3	[illegible]
08/19/99	0.8 J	[illegible]
12/02/99	2 U	[illegible]
05/09/00	1	[illegible]
05/02/01	5	[illegible]
05/15/02	NA	[illegible]
05/06/03	NA	[illegible]

LEGEND

- EXISTING PAVED ROADS
- EXISTING UNPAVED ROADS/TRAILS
- FENCE
- SHALLOW UPPER SAND WELL
- DEEP UPPER SAND WELL
- GROUNDWATER MANAGEMENT ZONE (GMZ) BOUNDARY

U = NOT DETECTED
J = ESTIMATED VALUE
NA = NOT ANALYZED

SHADED BOXES INDICATE EXCEEDANCE OF CLEAN-UP GOAL

NOTES:

1. FIGURE DEPICTS CURRENT AND HISTORIC CONTAMINANT CONCENTRATIONS FROM MONITORING WELLS SAMPLED ACCORDING TO THE SITE 45 REVISED LONG-TERM MONITORING PLAN.
2. SITE 45 CLEANUP GOALS ARE:
   SEC-BUTYLBENZENE - 7.3 UG/L
   MANGANESE - 1,500 UG/L

0 15 30 60
SCALE: FEET
1"=60'

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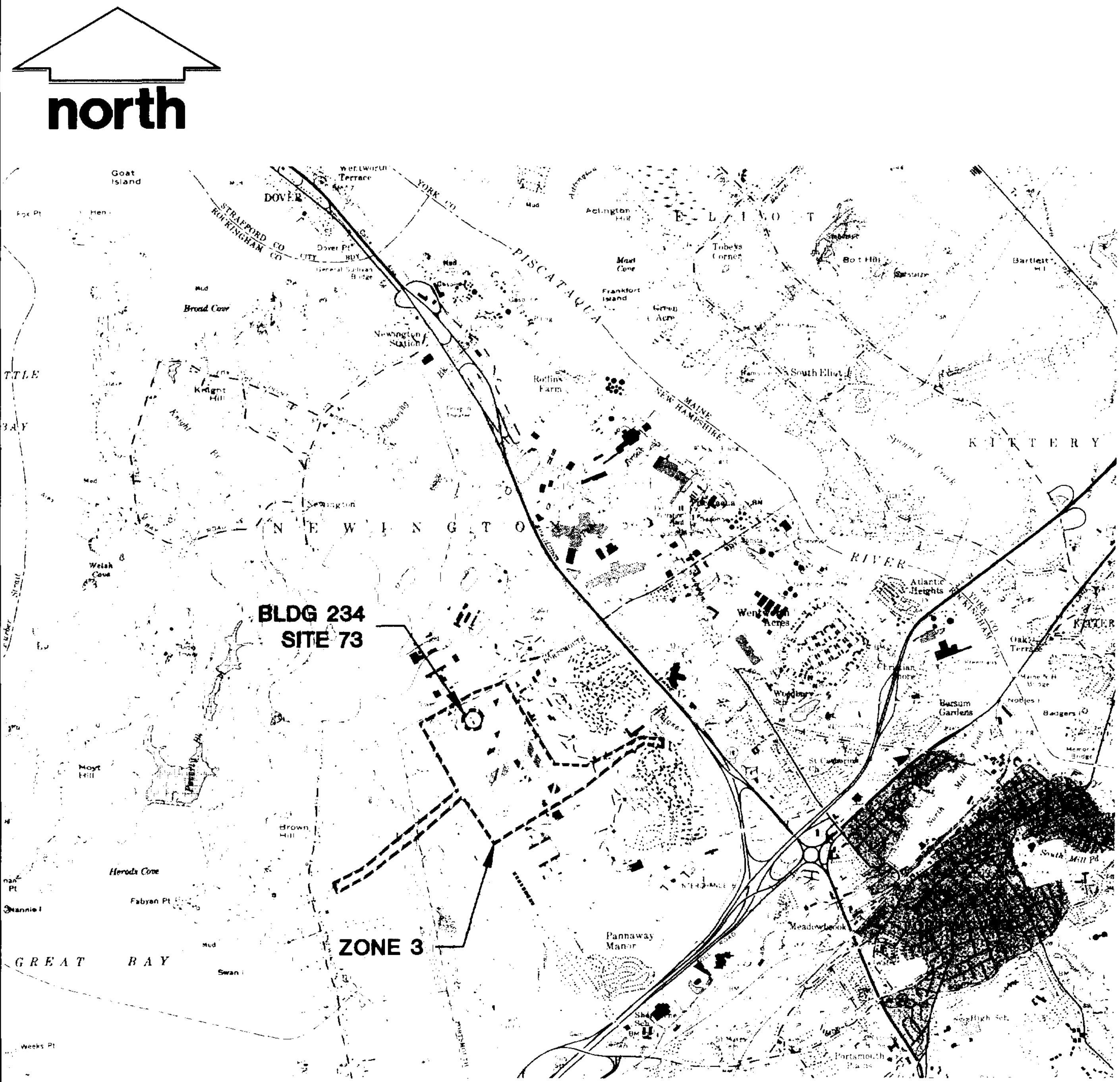
SITE 45
EXTENT OF GROUNDWATER CONTAMINATION

MWH

FIGURE 7.10-4



Source:
7.5 minute U.S.G.S. quadrangle of Portsmouth, NH-ME; dated 1956 and revised 1993.

0 1000 2000 4000
SCALE: FEET
1"=4000' (APPROX)

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SITE 73 SITE LOCATION MAP

MWH

FIGURE 7.11-1

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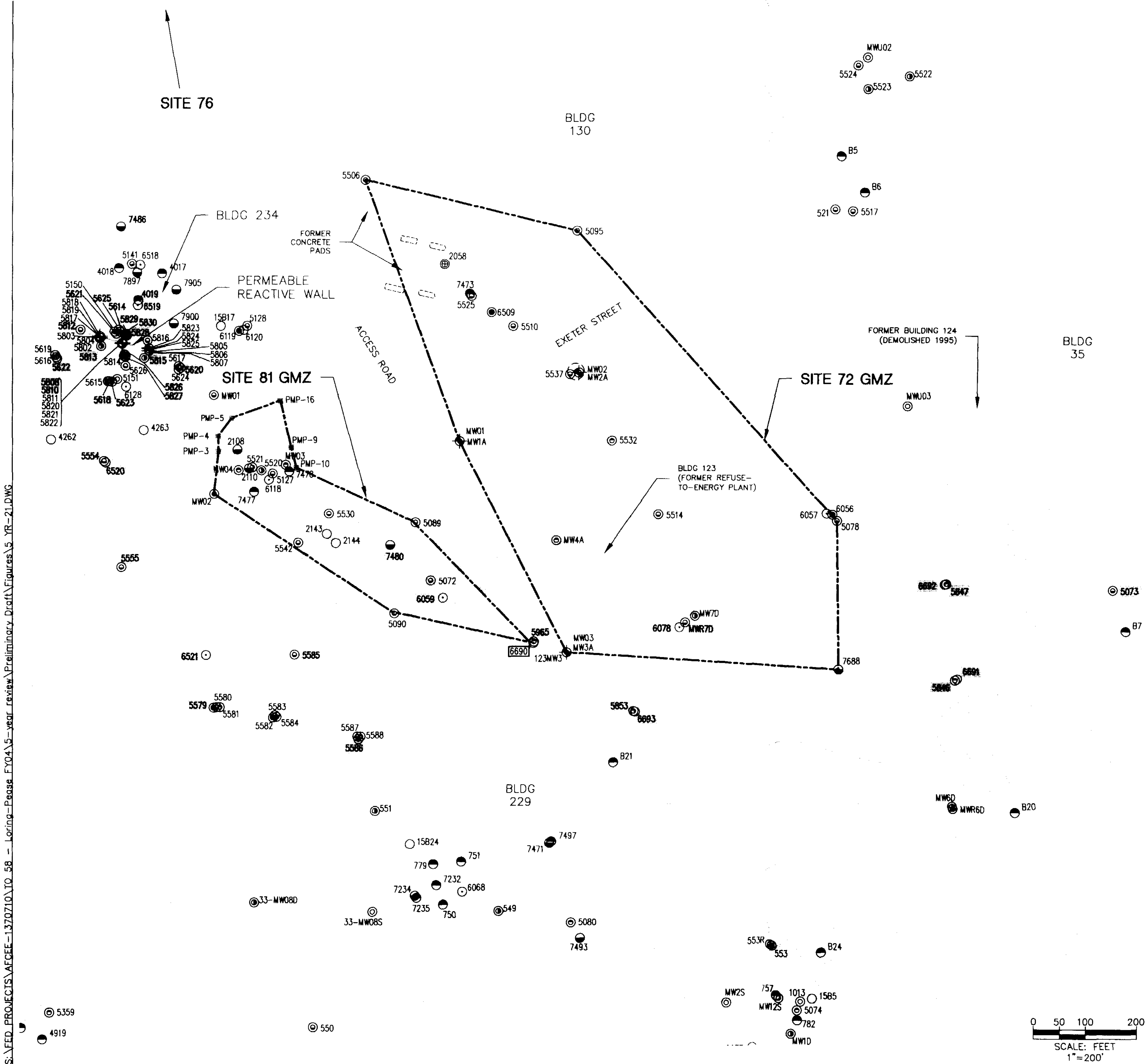
S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-21.DWG



north

LEGEND

- LOWER SAND OVERBURDEN MONITORING WELL
- UPPER SAND OVERBURDEN MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL
- HYBRID MONITORING WELL
- LOWER SAND OVERBURDEN PIEZOMETER
- UPPER SAND OVERBURDEN PIEZOMETER
- OVERBURDEN PIEZOMETER
- OVERBURDEN MONITORING WELL
- MONITORING WELL
- FENCE
- ROAD
- DRAINAGE DITCH/STREAM

NOTE:

1. SHADED WELLS WERE SAMPLED IN FALL 2003.
2. BOXED WELLS WERE SAMPLED IN SPRING 2003.

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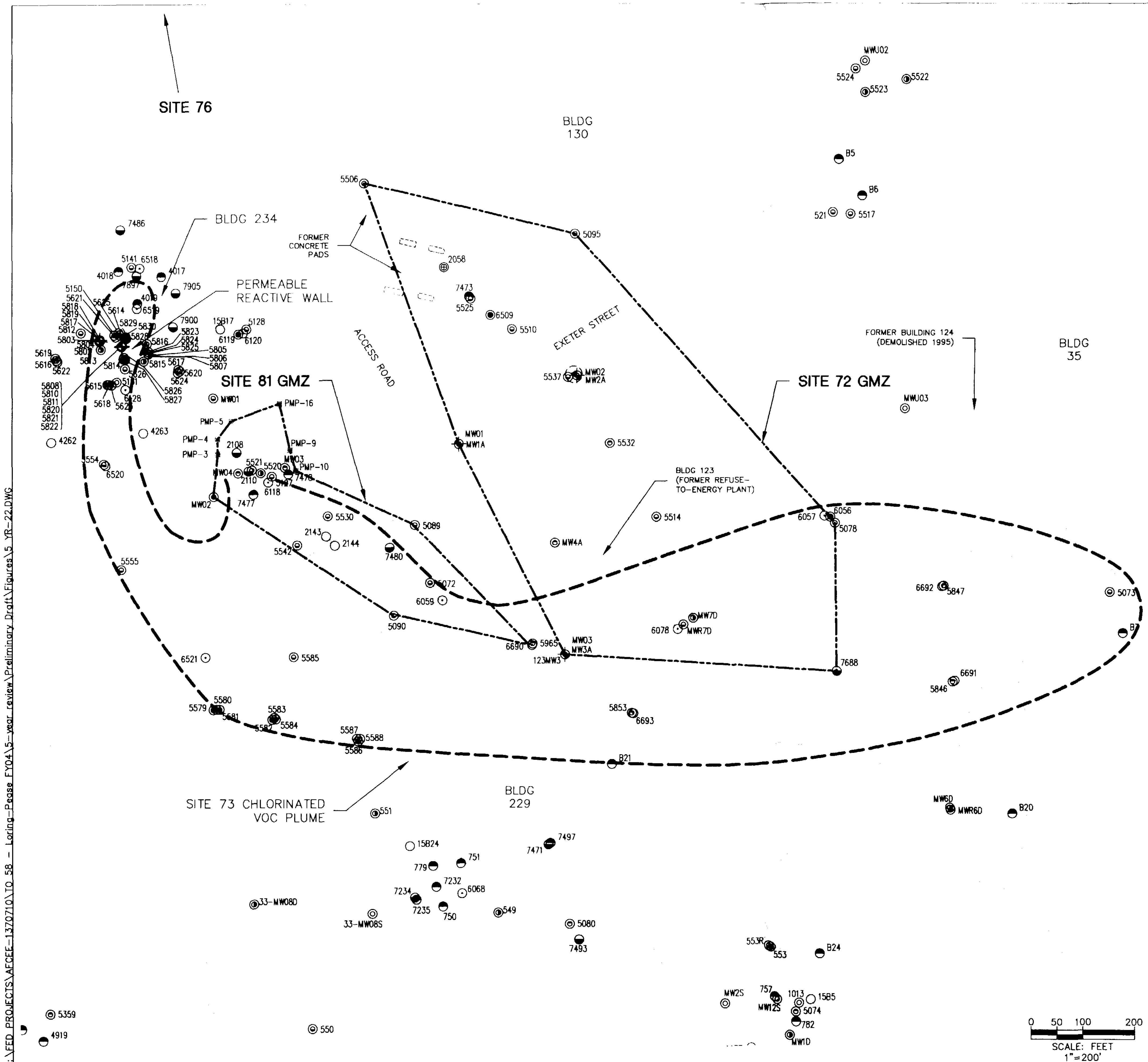
SITE 73 SITE FEATURES MAP

MWH

FIGURE 7.11-2

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-22.DWG



north

LEGEND

- LOWER SAND OVERBURDEN MONITORING WELL
- UPPER SAND OVERBURDEN MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL
- HYBRID MONITORING WELL
- LOWER SAND OVERBURDEN PIEZOMETER
- UPPER SAND OVERBURDEN PIEZOMETER
- OVERBURDEN PIEZOMETER
- OVERBURDEN MONITORING WELL
- MONITORING WELL
- FENCE
- ROAD
- DRAINAGE DITCH/STREAM

NOTE:

1. PLUME BOUNDARY IS APPROXIMATE AND IS BASED UPON CURRENT DETECTIONS OF CHLORINATED VOCs IN GROUNDWATER. PLUME BOUNDARY DOES NOT REFLECT EXCEEDANCES OF APPLICABLE NEW HAMPSHIRE AMBIENT GROUNDWATER QUALITY STANDARDS.

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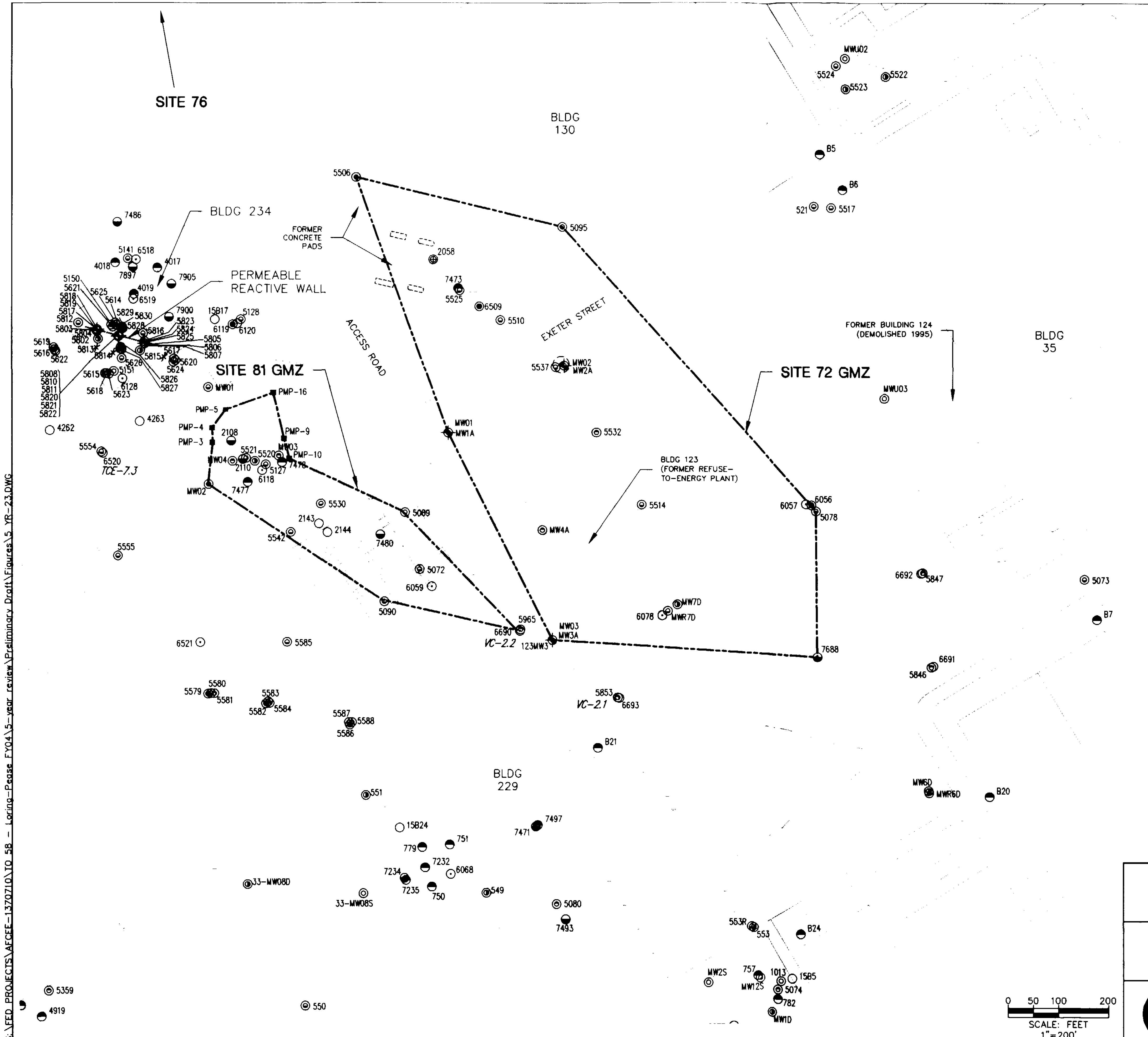
SITE 73 CHLORINATED VOLATILE ORGANIC COMPOUND GROUNDWATER PLUME

MWH

FIGURE 7.11-3



LEGEND

- LOWER SAND OVERBURDEN MONITORING WELL
- UPPER SAND OVERBURDEN MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL
- HYBRID MONITORING WELL
- LOWER SAND OVERBURDEN PIEZOMETER
- UPPER SAND OVERBURDEN PIEZOMETER
- OVERBURDEN PIEZOMETER
- OVERBURDEN MONITORING WELL
- MONITORING WELL
- FENCE
- ROAD
- DRAINAGE DITCH/STREAM

*

WELL ID	ANALYTE	CONCENTRATION
5813	TCE	10
5814	TCE cis 1,2 DCE	90 100
5815	TCE	42

NOTES:

1. PRB – PERMEABLE REACTIVE BARRIER.
2. TCE – TRICHLOROETHYLENE.
3. VC – VINYL CHLORIDE.
4. cis 1,2-DCE – cis 1,2 DICHLOROETHYLENE.
5. ALL CONCENTRATIONS ARE IN MICROGRAMS PER LITER ($\mu g/L$).
6. J – DENOTES THAT THE CONCENTRATION IS ESTIMATED.
7. NHAGQS – NEW HAMPSHIRE AMBIENT GROUNDWATER QUALITY STANDARDS.

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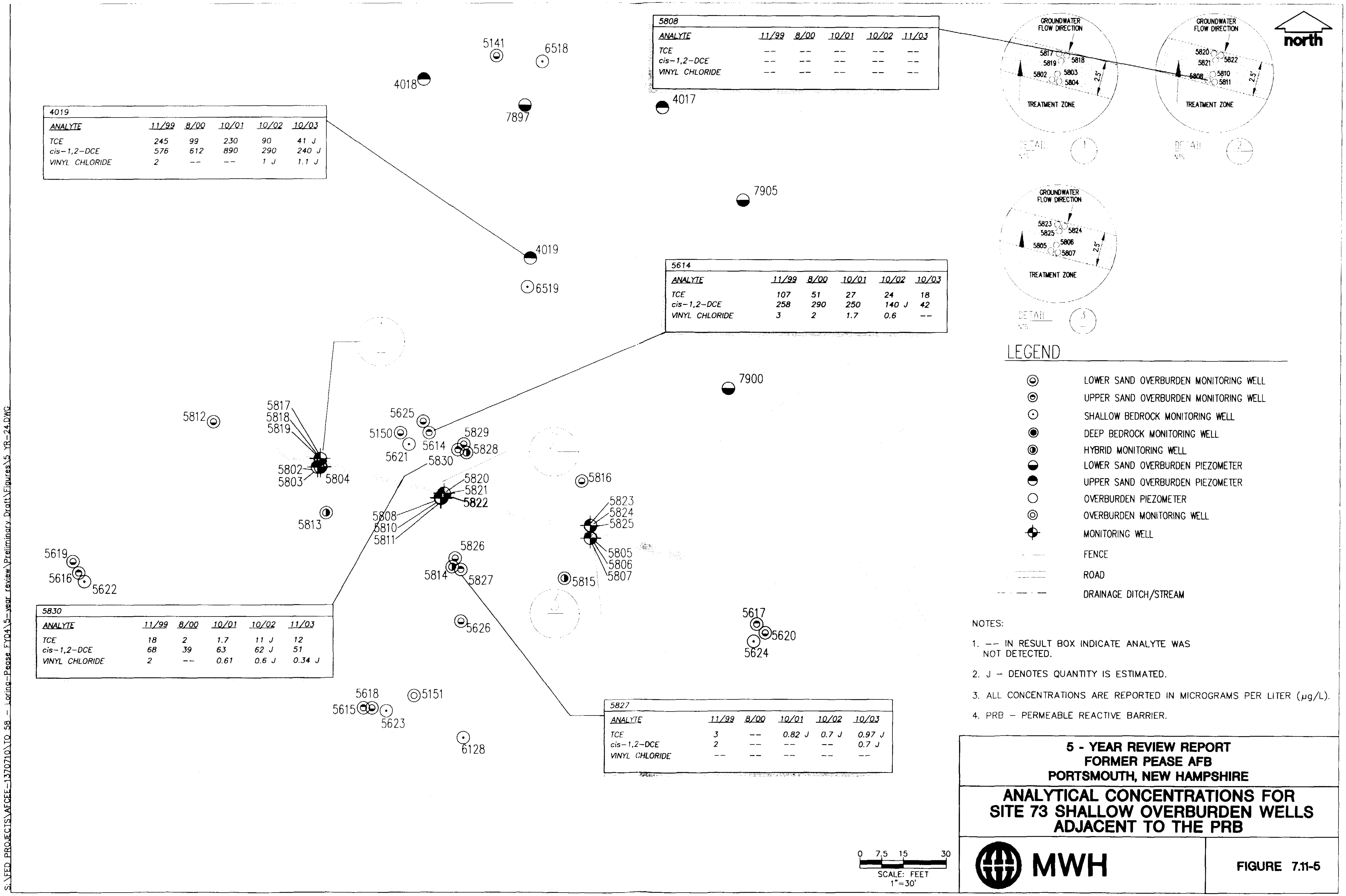
SITE 73 CHLORINATED VOCs EXCEEDING APPLICABLE RESTORATION GOALS DOWNGRADIENT OF THE PRB

MWH

FIGURE 7.11-4

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-24.DWG



4019

ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	245	99	230	90	41 J
cis-1,2-DCE	576	612	890	290	240 J
VINYL CHLORIDE	2	--	--	1 J	1.1 J

5808

ANALYTE	11/99	8/00	10/01	10/02	11/03
TCE	--	--	--	--	--
cis-1,2-DCE	--	--	--	--	--
VINYL CHLORIDE	--	--	--	--	--

5614

ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	107	51	27	24	18
cis-1,2-DCE	258	290	250	140 J	42
VINYL CHLORIDE	3	2	1.7	0.6	--

5830

ANALYTE	11/99	8/00	10/01	10/02	11/03
TCE	18	2	1.7	11 J	12
cis-1,2-DCE	68	39	63	62 J	51
VINYL CHLORIDE	2	--	0.61	0.6 J	0.34 J

5827

ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	3	--	0.82 J	0.7 J	0.97 J
cis-1,2-DCE	2	--	--	--	0.7 J
VINYL CHLORIDE	--	--	--	--	--

LEGEND

- LOWER SAND OVERBURDEN MONITORING WELL
- UPPER SAND OVERBURDEN MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL
- HYBRID MONITORING WELL
- LOWER SAND OVERBURDEN PIEZOMETER
- UPPER SAND OVERBURDEN PIEZOMETER
- OVERBURDEN PIEZOMETER
- OVERBURDEN MONITORING WELL
- MONITORING WELL
- FENCE
- ROAD
- DRAINAGE DITCH/STREAM

NOTES:

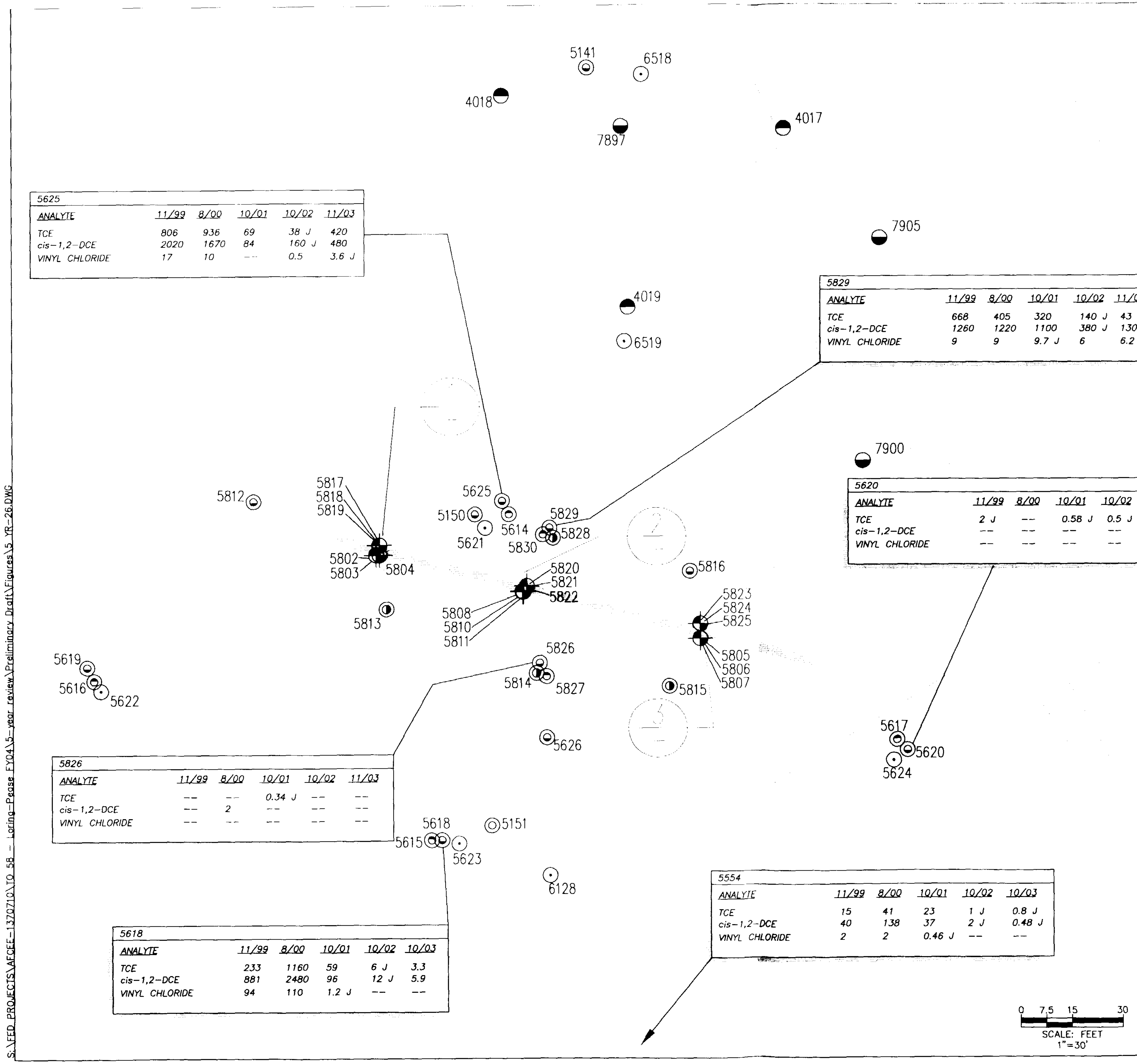
1. -- IN RESULT BOX INDICATE ANALYTE WAS NOT DETECTED.
2. J - DENOTES QUANTITY IS ESTIMATED.
3. ALL CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (μg/L).
4. PRB - PERMEABLE REACTIVE BARRIER.

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

ANALYTICAL CONCENTRATIONS FOR SITE 73 SHALLOW OVERBURDEN WELLS ADJACENT TO THE PRB

MWH

FIGURE 7.11-5



5625					
ANALYTE	11/99	8/00	10/01	10/02	11/03
TCE	806	936	69	38 J	420
cis-1,2-DCE	2020	1670	84	160 J	480
VINYL CHLORIDE	17	10	--	0.5	3.6 J

5829					
ANALYTE	11/99	8/00	10/01	10/02	11/03
TCE	668	405	320	140 J	43
cis-1,2-DCE	1260	1220	1100	380 J	130 J
VINYL CHLORIDE	9	9	9.7 J	6	6.2

5620					
ANALYTE	11/99	8/00	10/01	10/02	11/03
TCE	2 J	--	0.58 J	0.5 J	0.76 J
cis-1,2-DCE	--	--	--	--	--
VINYL CHLORIDE	--	--	--	--	--

5826					
ANALYTE	11/99	8/00	10/01	10/02	11/03
TCE	--	--	0.34 J	--	--
cis-1,2-DCE	--	2	--	--	--
VINYL CHLORIDE	--	--	--	--	--

5554					
ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	15	41	23	1 J	0.8 J
cis-1,2-DCE	40	138	37	2 J	0.48 J
VINYL CHLORIDE	2	2	0.46 J	--	--

5618					
ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	233	1160	59	6 J	3.3
cis-1,2-DCE	881	2480	96	12 J	5.9
VINYL CHLORIDE	94	110	1.2 J	--	--

LEGEND

- LOWER SAND OVERBURDEN MONITORING WELL
- UPPER SAND OVERBURDEN MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL
- HYBRID MONITORING WELL
- LOWER SAND OVERBURDEN PIEZOMETER
- UPPER SAND OVERBURDEN PIEZOMETER
- OVERBURDEN PIEZOMETER
- OVERBURDEN MONITORING WELL
- MONITORING WELL
- FENCE
- ROAD
- DRAINAGE DITCH/STREAM

NOTES:

1. -- IN RESULT BOX INDICATE ANALYTE WAS NOT DETECTED.
2. J - DENOTES QUANTITY IS ESTIMATED.
3. ALL CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (μg/L).
4. PRB - PERMEABLE REACTIVE BARRIER.

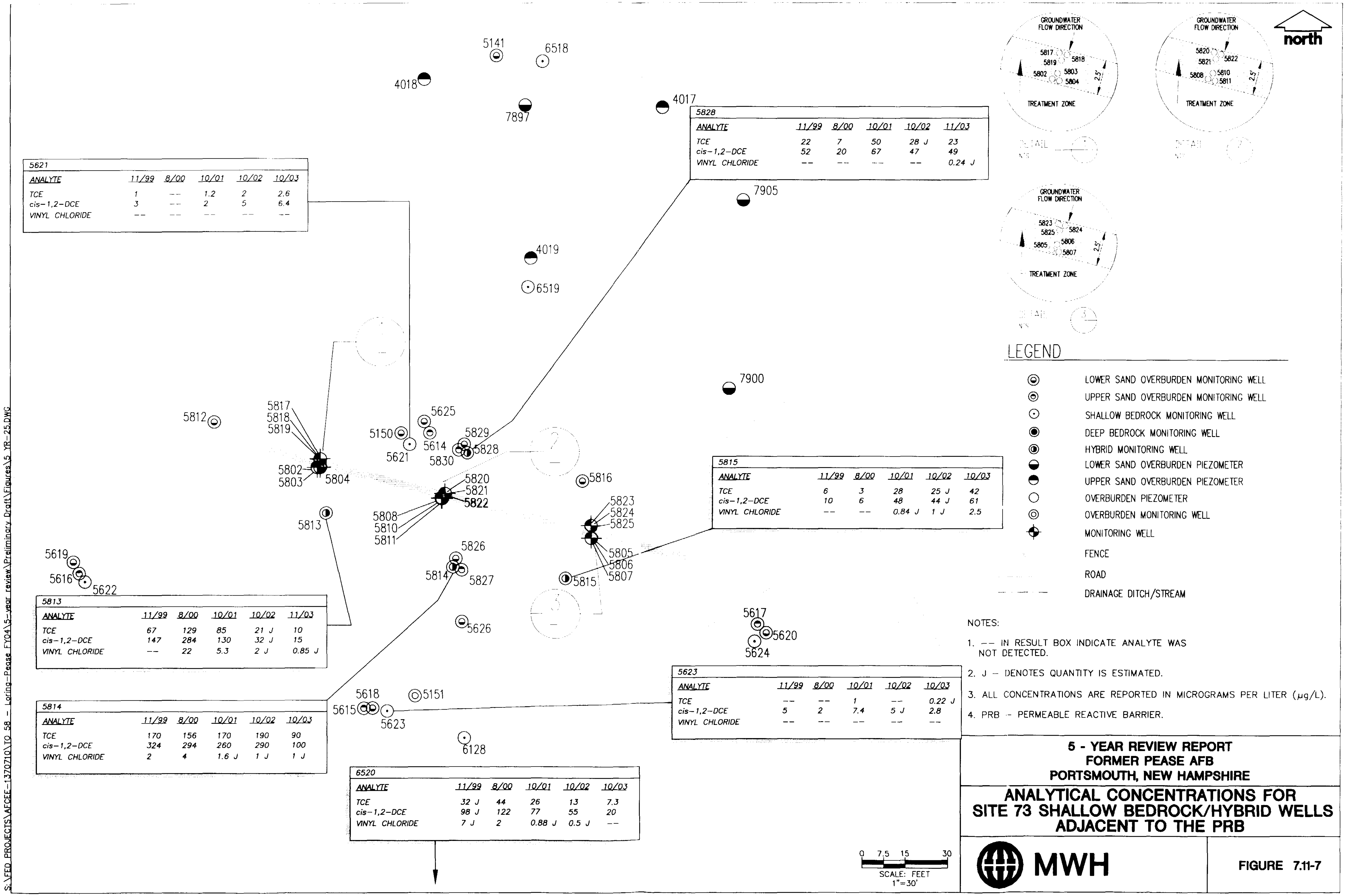
5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

ANALYTICAL CONCENTRATIONS FOR SITE 73 DEEP OVERBURDEN WELLS ADJACENT TO THE PRB

MWH

FIGURE 7.11-6

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-25.DWG



5621

ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	1	--	1.2	2	2.6
cis-1,2-DCE	3	--	2	5	6.4
VINYL CHLORIDE	--	--	--	--	--

5828

ANALYTE	11/99	8/00	10/01	10/02	11/03
TCE	22	7	50	28 J	23
cis-1,2-DCE	52	20	67	47	49
VINYL CHLORIDE	--	--	--	--	0.24 J

5815

ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	6	3	28	25 J	42
cis-1,2-DCE	10	6	48	44 J	61
VINYL CHLORIDE	--	--	0.84 J	1 J	2.5

5813

ANALYTE	11/99	8/00	10/01	10/02	11/03
TCE	67	129	85	21 J	10
cis-1,2-DCE	147	284	130	32 J	15
VINYL CHLORIDE	--	22	5.3	2 J	0.85 J

5814

ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	170	156	170	190	90
cis-1,2-DCE	324	294	260	290	100
VINYL CHLORIDE	2	4	1.6 J	1 J	1 J

5623

ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	--	--	1	--	0.22 J
cis-1,2-DCE	5	2	7.4	5 J	2.8
VINYL CHLORIDE	--	--	--	--	--

6520

ANALYTE	11/99	8/00	10/01	10/02	10/03
TCE	32 J	44	26	13	7.3
cis-1,2-DCE	98 J	122	77	55	20
VINYL CHLORIDE	7 J	2	0.88 J	0.5 J	--

NOTES:

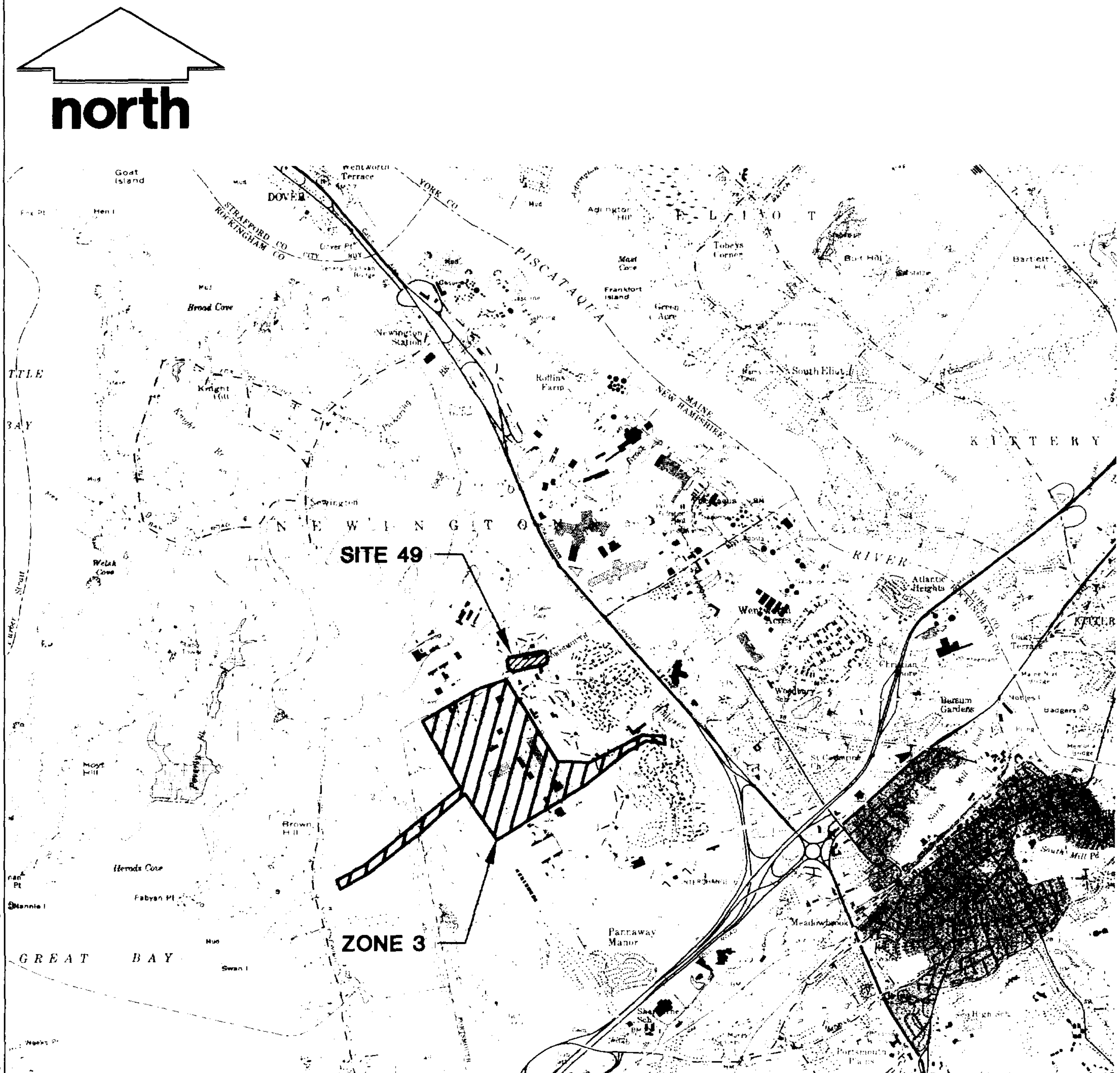
1. -- IN RESULT BOX INDICATE ANALYTE WAS NOT DETECTED.
2. J - DENOTES QUANTITY IS ESTIMATED.
3. ALL CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER ($\mu g/L$).
4. PRB - PERMEABLE REACTIVE BARRIER.

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

ANALYTICAL CONCENTRATIONS FOR SITE 73 SHALLOW BEDROCK/HYBRID WELLS ADJACENT TO THE PRB

MWH

FIGURE 7.11-7



Source:
7.5 minute U.S.G.S. quadrangle of Portsmouth, NH-ME; dated 1956 and revised 1993.

0 1000 2000 4000
SCALE: FEET
1"=4000' (APPROX)

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

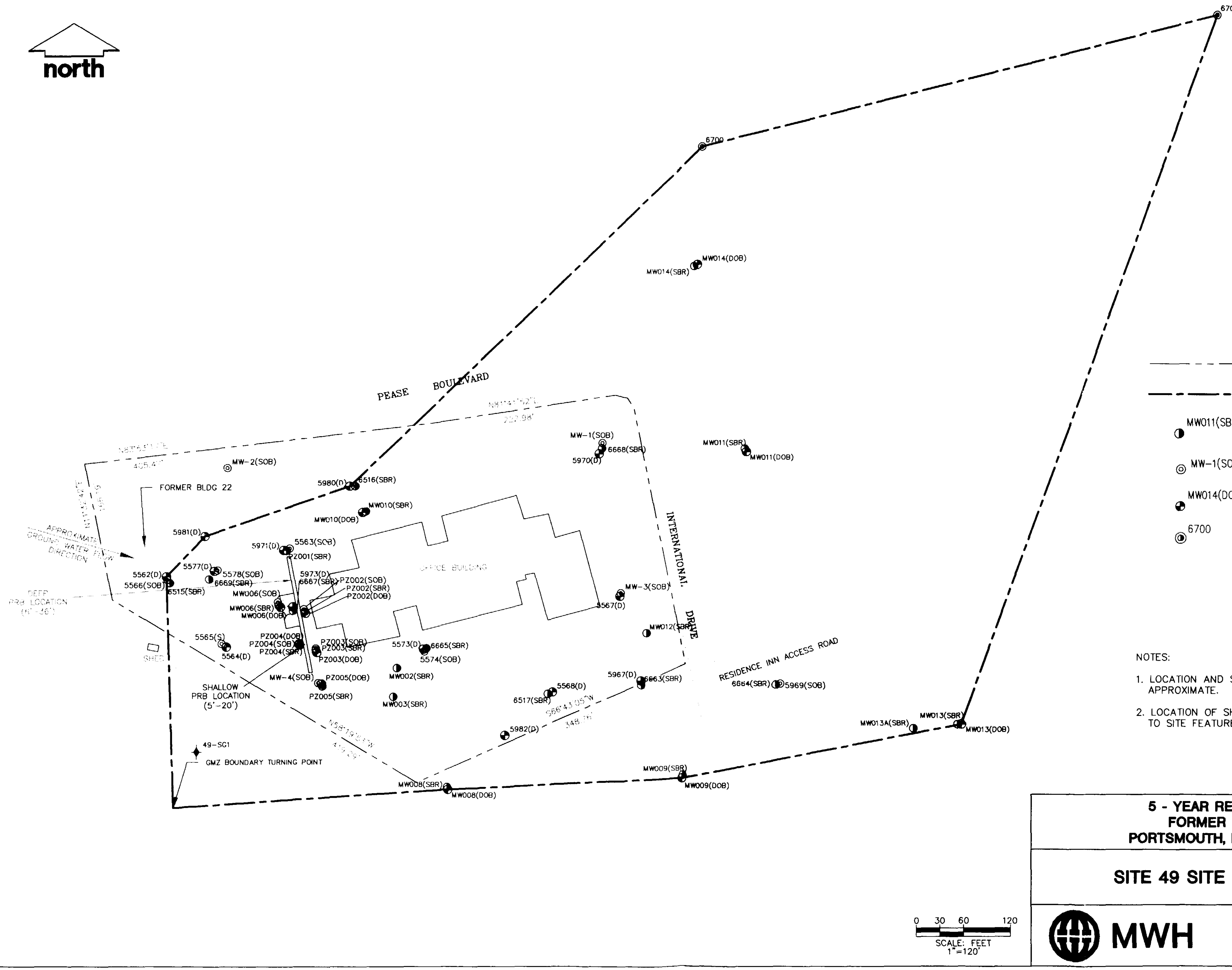
SITE 49 SITE LOCATION MAP

MWH

FIGURE 7.12-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-27.DWG

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-28.DWG



LEGEND

	PROPERTY LINE
	GROUNDWATER MANAGEMENT ZONE (GMZ) BOUNDARY
MW011(SBR)	SHALLOW BEDROCK MONITORING WELL LOCATION
MW-1(SOB)	SHALLOW OVERBURDEN MONITORING WELL LOCATION
MW014(DOB)	DEEP OVERBURDEN MONITORING WELL LOCATION
6700	HYBRID MONITORING WELL

NOTES:

1. LOCATION AND SIZE OF OFFICE BUILDING IS APPROXIMATE.
2. LOCATION OF SHALLOW AND DEEP PRB WITH RESPECT TO SITE FEATURES ARE APPROXIMATE.

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

SITE 49 SITE FEATURES MAP

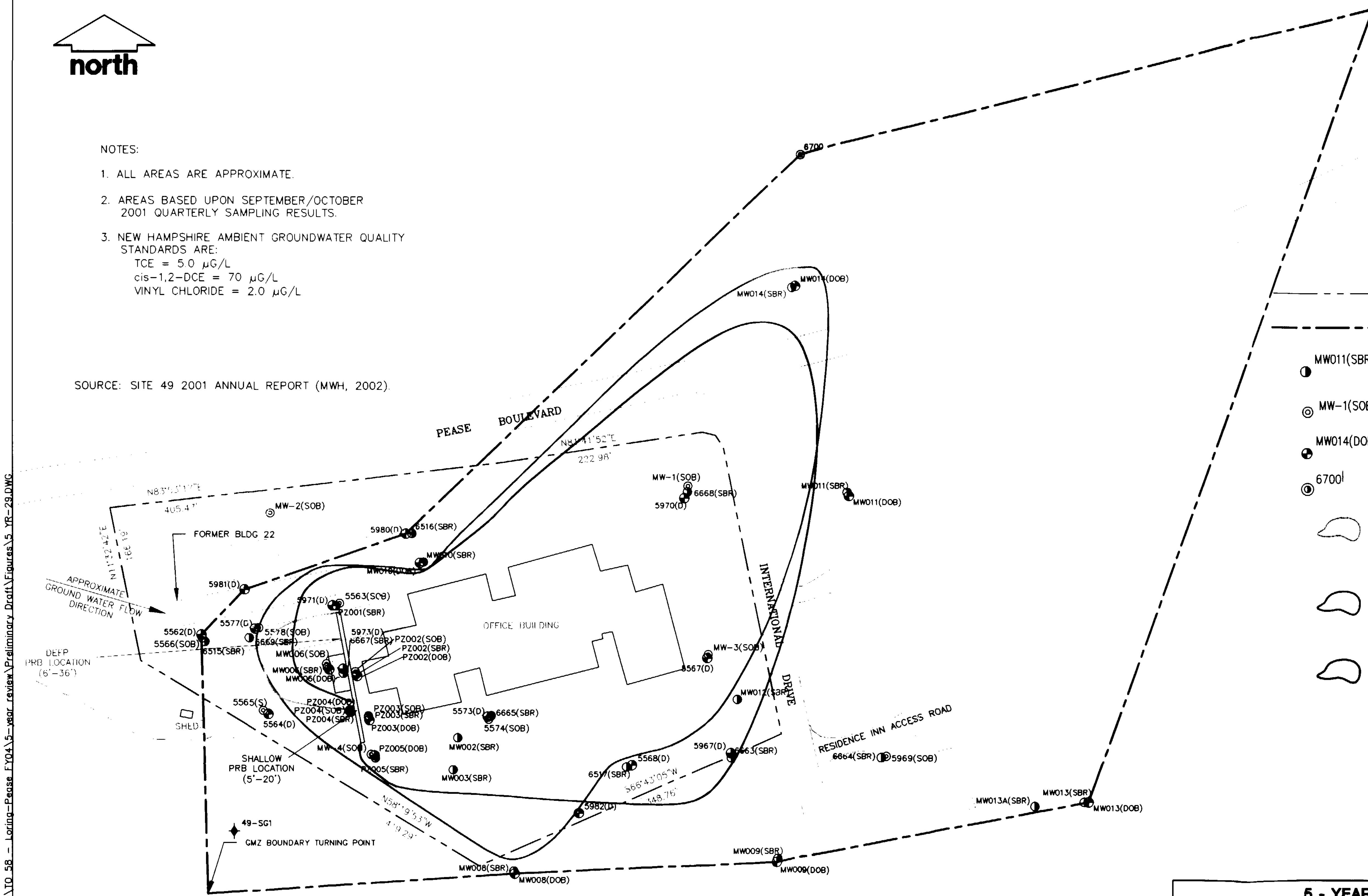
MWH

FIGURE 7.12-2

NOTES:

1. ALL AREAS ARE APPROXIMATE.
2. AREAS BASED UPON SEPTEMBER/OCTOBER 2001 QUARTERLY SAMPLING RESULTS.
3. NEW HAMPSHIRE AMBIENT GROUNDWATER QUALITY STANDARDS ARE:
   TCE = 5.0 $\mu G/L$
   cis-1,2-DCE = 70 $\mu G/L$
   VINYL CHLORIDE = 2.0 $\mu G/L$

SOURCE: SITE 49 2001 ANNUAL REPORT (MWH, 2002).



LEGEND

PROPERTY LINE

GROUNDWATER MANAGEMENT ZONE (GMZ) BOUNDARY

MW011(SBR) SHALLOW BEDROCK MONITORING WELL LOCATION

MW-1(SOB) SHALLOW OVERBURDEN MONITORING WELL LOCATION

MW014(DOB) DEEP OVERBURDEN MONITORING WELL LOCATION

6700 HYBRID MONITORING WELL

SHALLOW OVERBURDEN AREA EXCEEDING CLEAN UP GOALS FOR cis-1,2-DCE, TCE OR VINYL CHLORIDE

DEEP OVERBURDEN AREA EXCEEDING CLEAN UP GOALS FOR cis-1,2-DCE, TCE OR VINYL CHLORIDE

SHALLOW BEDROCK/HYBRID AREA EXCEEDING CLEAN UP GOALS FOR cis-1,2-DCE, TCE OR VINYL CHLORIDE

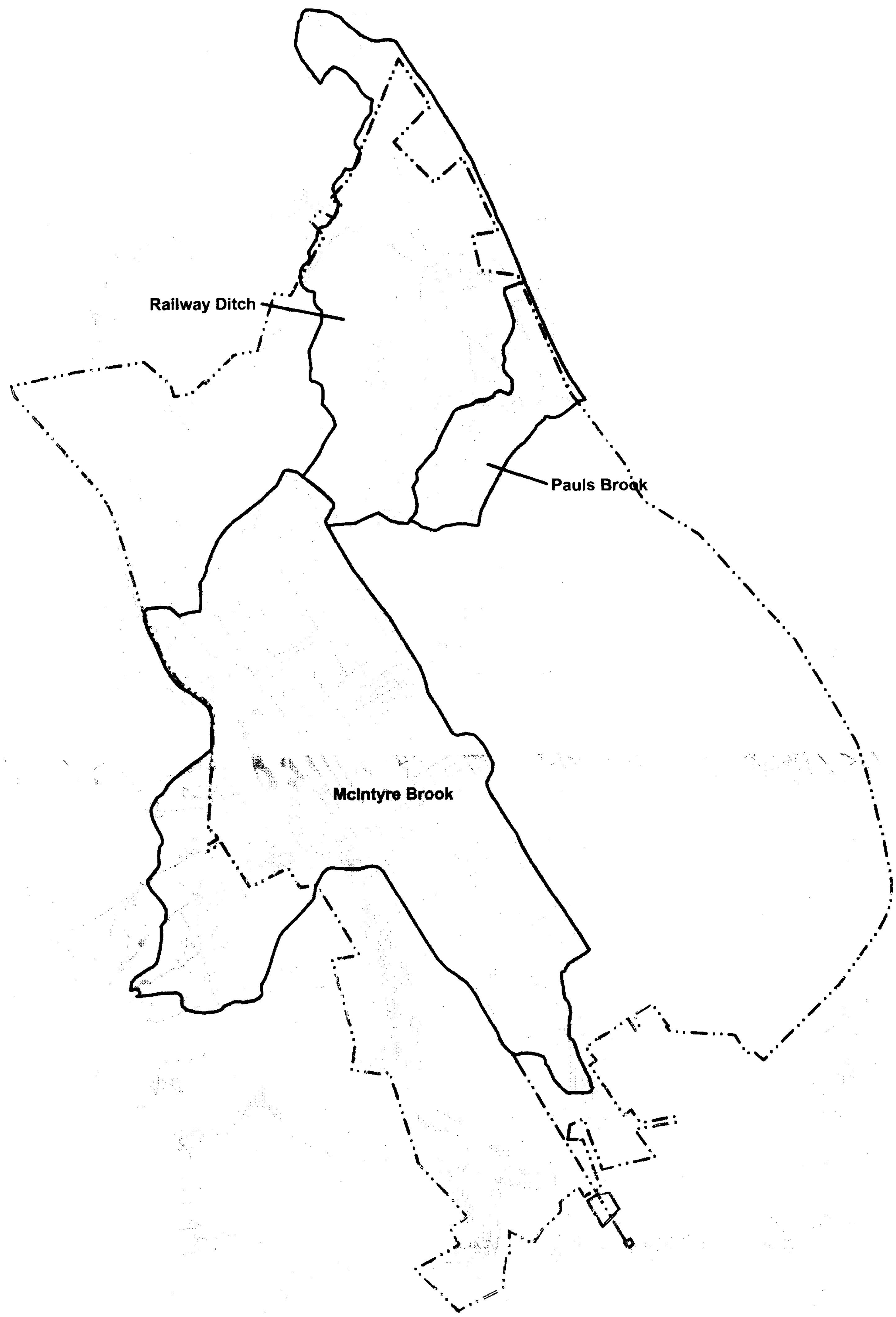
5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

SITE 49
AREA OF CLEANUP GOAL EXCEEDANCES BY STRATIGRAPHIC UNIT

MWH

FIGURE 7.12-3

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-29.DWG



LEGEND

SITE LOCATION

WETLAND RESTORATION/PRESERVATION AREA

STREAM/DITCH

FORMER BASE BOUNDARY

north

0 500 1000 2000

SCALE: FEET
1"=2000'

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

CATEGORY 2 SITE LOCATIONS

MWH

FIGURE 8.1-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\figures\5 YR-33.DWG

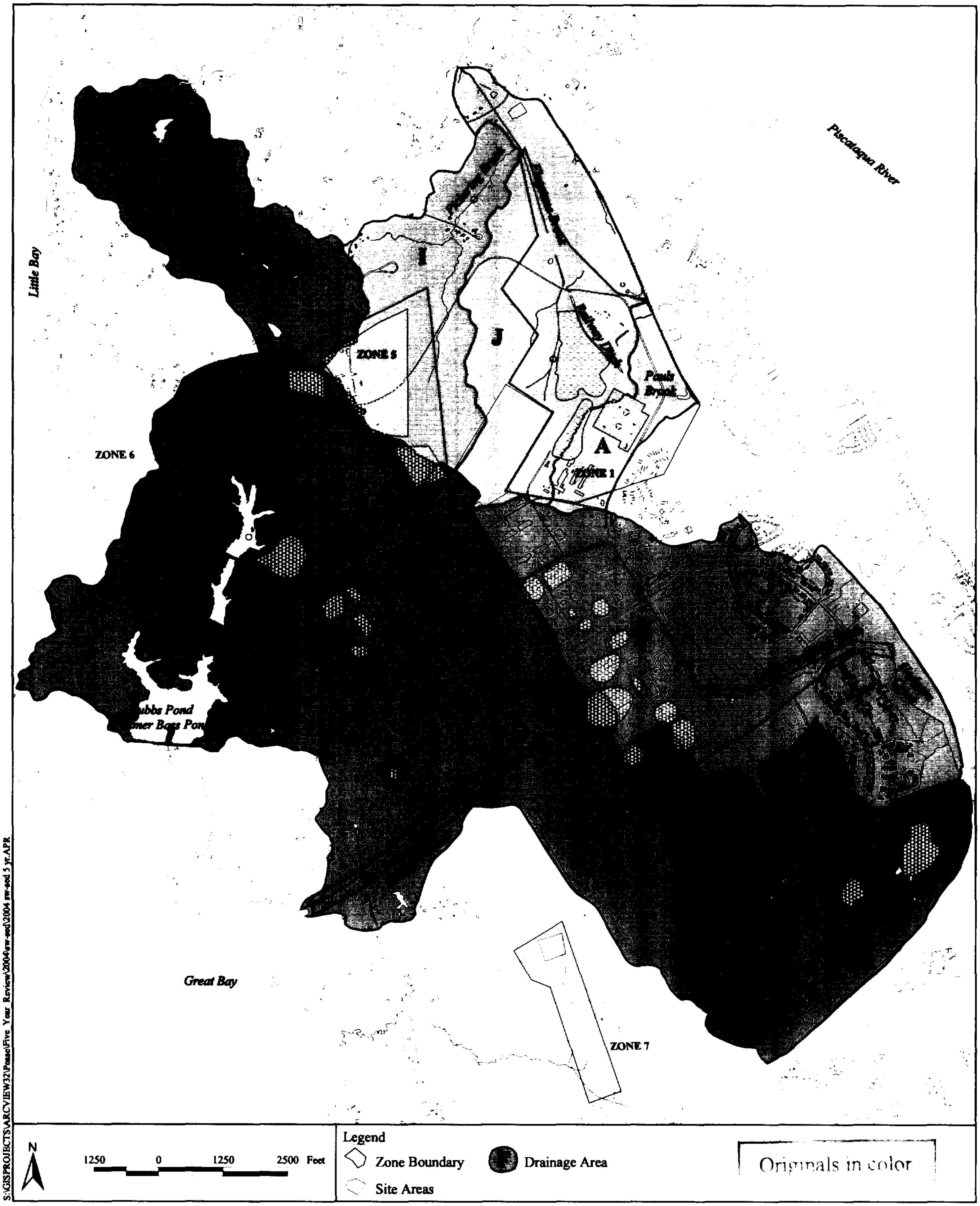


Figure 8.4-1
SURFACE WATER/SEDIMENT
LONG-TERM MONITORING
SITE LOCATION MAP

5 Year Review Report
Former Pease AFB
Portsmouth, New Hampshire

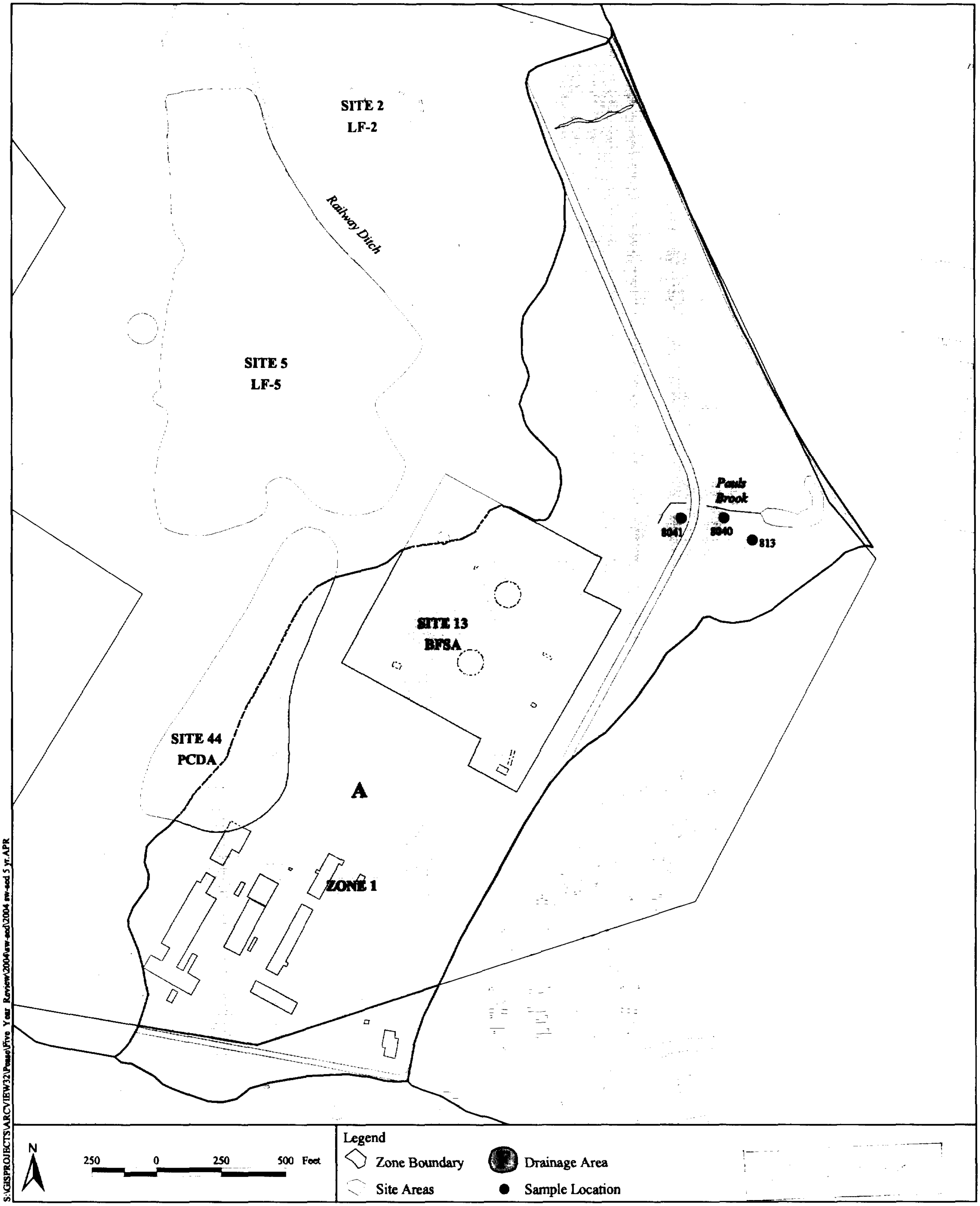
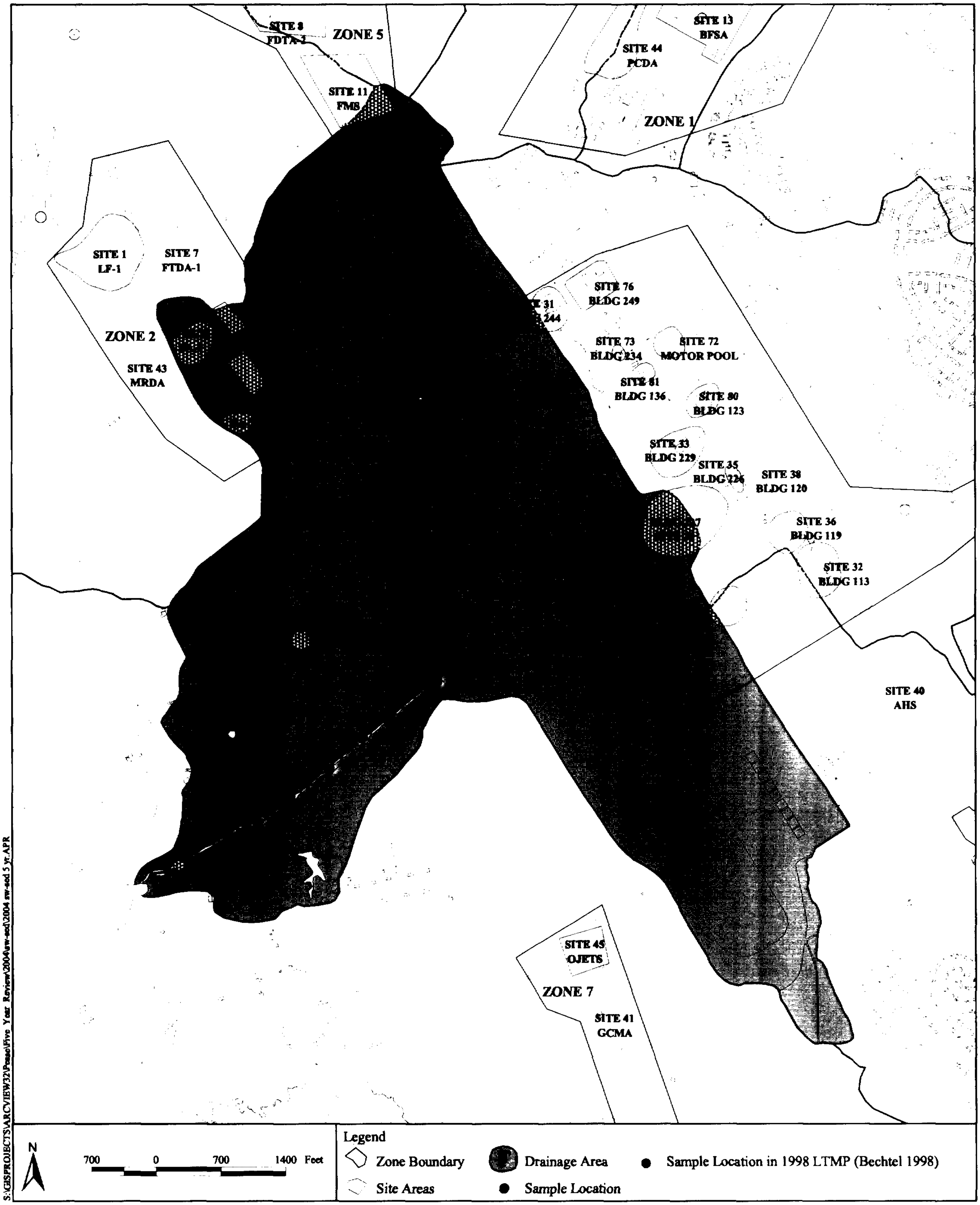


Figure 8.4-2
PAULS BROOK
SITE FEATURES MAP

5 Year Review Report
Former Pease AFB
Portsmouth, New Hampshire



Originals in color.

Figure 8.5-1
McINTYRE BROOK
SITE FEATURES MAP

5 Year Review Report
Former Pease AFB
Portsmouth, New Hampshire

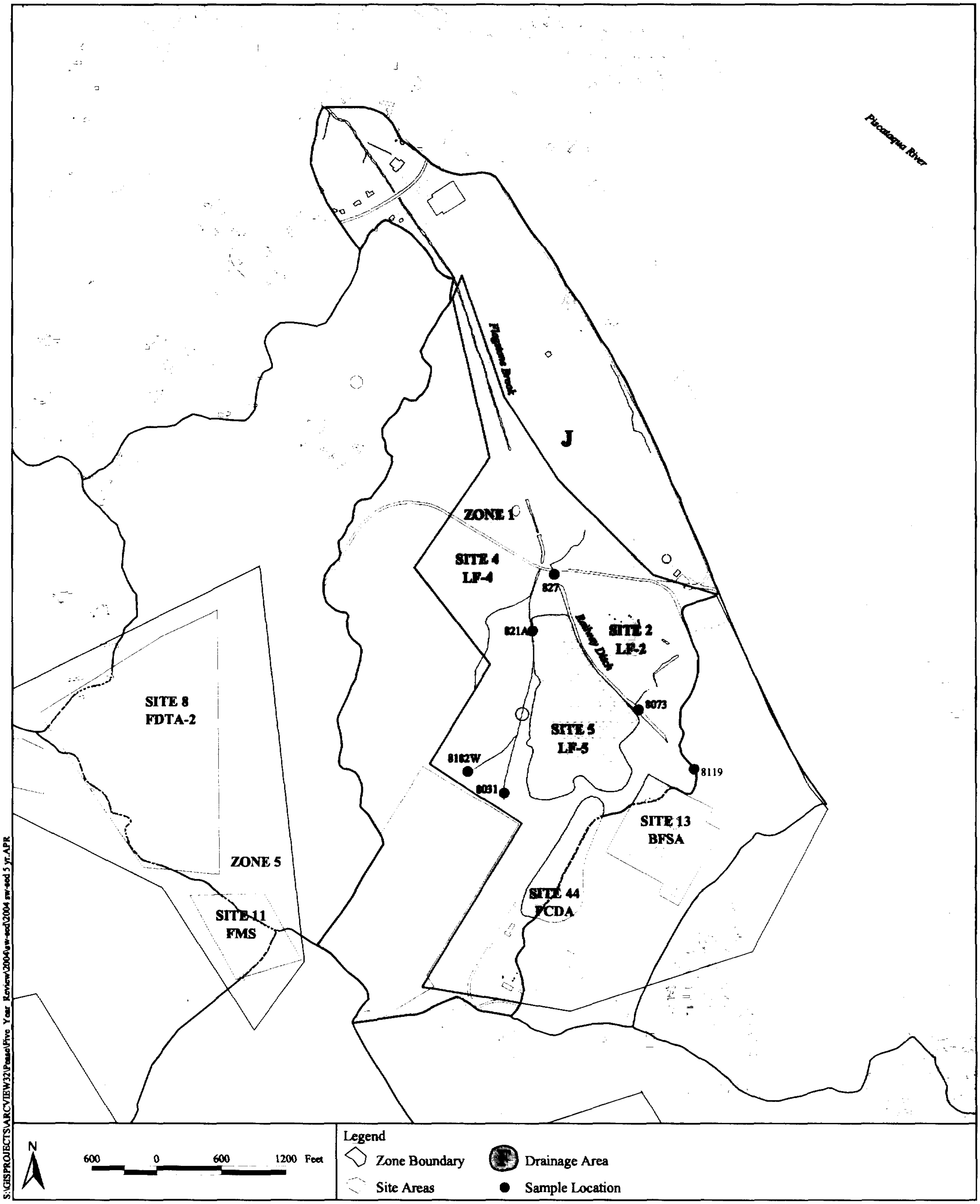
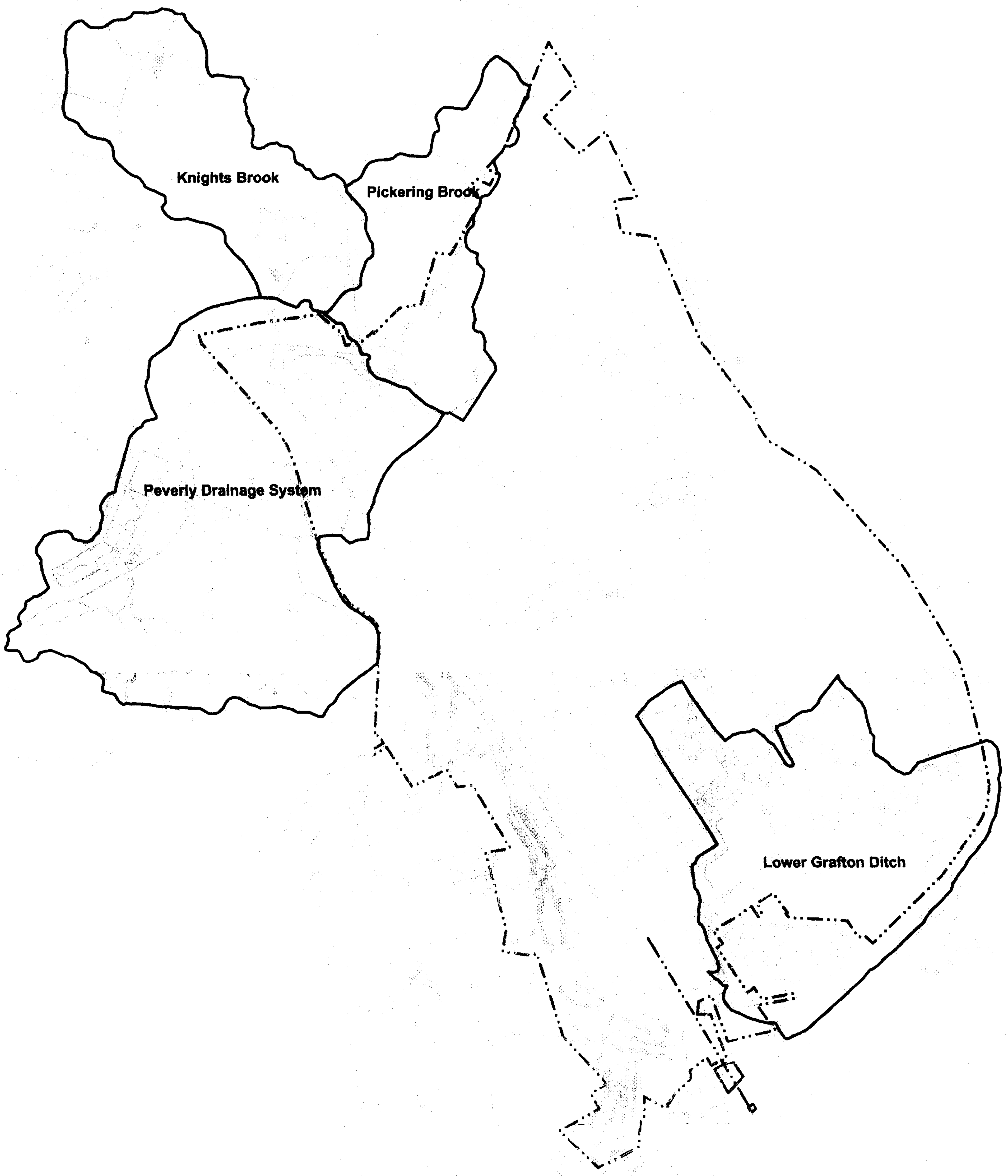


Figure 8.6-1
RAILWAY DITCH
SITE FEATURES MAP



LEGEND

- SITE LOCATION
- WETLAND RESTORATION/PRESERVATION AREA
- STREAM/DITCH
- FORMER BASE BOUNDARY

north

0 500 1000 2000
SCALE: FEET
1"=2000'

5 - YEAR REVIEW REPORT
FORMER PEASE AFB
PORTSMOUTH, NEW HAMPSHIRE

CATEGORY 3 SITE LOCATIONS

MWH

FIGURE 9.1-1

S:\FED PROJECTS\AFCEE-1370710\TO 58 - Loring-Pease FY04\5-year review\Preliminary Draft\Figures\5 YR-34.DWG

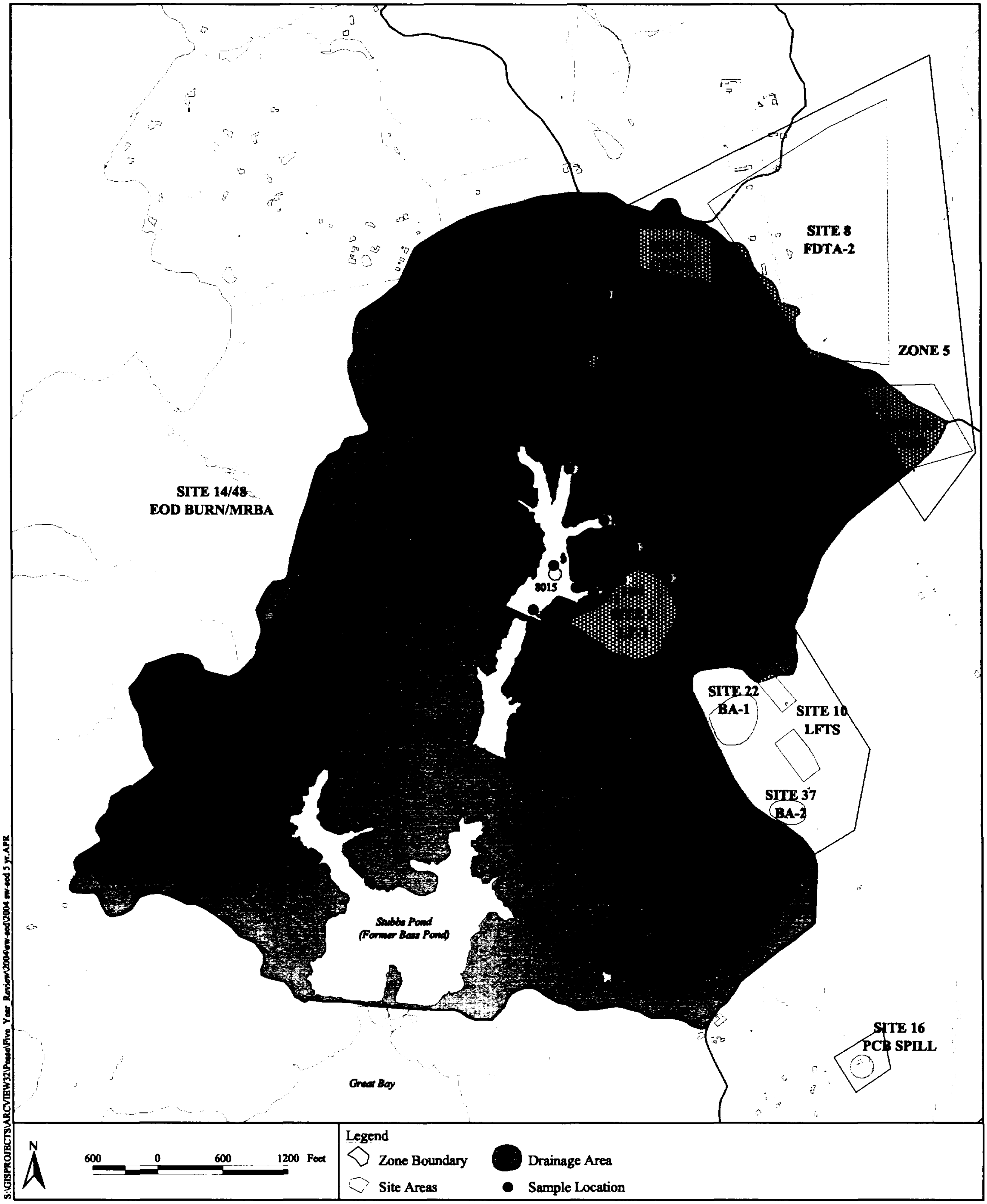


Figure 9.4-1
PEVERLY DRAINAGE SYSTEM
SITE FEATURES MAP

Originals in color.

5 Year Review Report
Former Pease AFB
Portsmouth, New Hampshire

S:\GISPROJECTS\ARCVIEW32\Pease\Five Year Review\2004\sw-sed\2004 sw-sed 5 yr.APR

Figure 9.5-1
LOWER GRAFTON DITCH
SITE FEATURES MAP

5 Year Review Report
Former Pease AFB
Portsmouth, New Hampshire

Originals in color

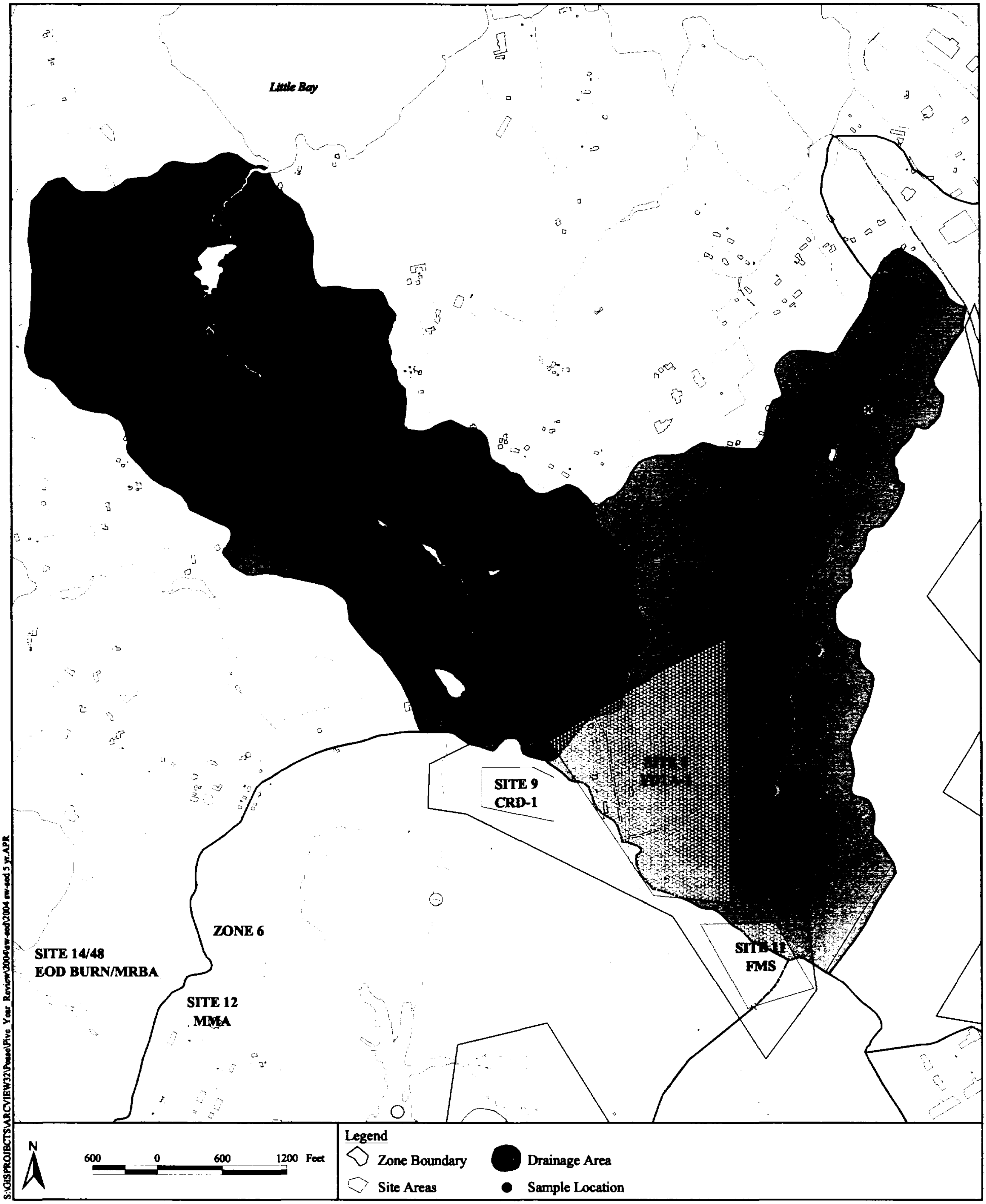


Figure 9.6-1
KNIGHTS BROOK
SITE FEATURES MAP

5 Year Review Report
Former Pease AFB
Portsmouth, New Hampshire

Table 6.2-1

Summary of Pease Five Year Review Report (1999-2004)
Former Pease AFB, Portsmouth, NH

Site ID[1]	Site Names[2]	Category 1[3]	Category 2[4]	Category 3[5]	Location in Report
Zone 1, Landfill 5	Landfill 5	X			Section 7.4
Zone 2	Leaded Fuel Tank Sludge Area (LFTS, Site 10); Burn Area 1 (BA-1, Site 22); Burn Area 2 (BA-2, Site 37); McIntyre Road Drum Disposal Area (MRDDA, Site 43)	X			Section 7.5
Zone 3, Sites 32/36	Building 113 and Building 119	X			Section 7.6
Zone 3, Sites 34/39	Building 229 (Site 33); Building 222 (Jet Engine Test Cell [JETC]- Site 34); Building 120 (Site 38); Building 227 (Site 39)	X			Section 7.7
Zone 4, Landfill 6	Landfill 6 (LF-6)	X			Section 7.8
Zone 5, Site 8	Fire Department Training Area 2 (FDTA-2)	X			Section 7.9
Zone 7, Site 45	Old Jet Engine Test Stand (OJETS)	X			Section 7.10
Zone 3, Site 73	Building 234	X			Section 7.11

Table 6.2-1

Summary of Pease Five Year Review Report (1999-2004)
Former Pease AFB, Portsmouth, NH

Site ID[1]	Site Names[2]	Category 1[3]	Category 2[4]	Category 3[5]	Location in Report
Zone 3, Site 49	Building 22	X			Section 7.12
Zone 1, Pauls Brook	Pauls Brook		X		Section 8.4
Zone 3, McIntyre Brook	McIntyre Brook		X		Section 8.5
Zone 1, Railway Ditch	Railway Ditch and Flagstone Brook		X		Section 8.6
Zone 2, Peverly Drainage System	Peverly Brook, Upper Peverly Pond, Lower Peverly Pond, Stubbs Pond			X	Section 9.4
Zone 4, Lower Grafton Ditch	Grafton Ditch			X	Section 9.5
Zone 5, Knights Brook and Pickering Brook	Knights Brook and Pickering Brook			X	Section 9.6

[1] IRP Zone and site identifier in Bechtel 1999 Five-Year Review Report.

[2] Sites included in 5-Year Review.

[3] Remedial Action Implemented

[4] Long-Term Monitoring only, Surface Water/Sediment with remedial actions completed

[5] Long-Term Monitoring only, Surface Water /Sediment

Table 7.2-1
Category 1 Sites (Remedial Action Implemented)
Data Summary Table
Five-Year Review Report
Former Pease Air Force Base, Portsmouth, NH
Page 1 of 8

Site I.D.(1)	Sites Included(2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations from Last 5-Year Review (6)	Remarks (7)
Zone 1, Landfill 5	Landfill 5 (LF-5)	Roy F. Weston (Weston), 1992: Landfill 5 Remedial Investigation (RI) Report; Weston 1992: Stage 3C Landfill 5 Feasibility Study (FS); Weston, 1993: Zone 1 RI Report; Weston, 1993: Record of Decision (ROD) for Source Area Remedial Action at Landfill 5; Weston, 1995: Zone 1 ROD; USAF, 1998: LF-5 Operating Properly and Successfully (OPS) Document; Bechtel, 1999: Five-Year Review Report	LF-5 is located in Zone 1, in the northeastern portion of the former Pease AFB. The original landfill consisted of approximately 23 acres; consolidation of wastes during remedial action resulted in a capped area of approximately 18.5 acres. LF-5 reportedly was used between 1964 and 1975 as the primary base landfill, although some disposal occurred as late as 1979. Most of the material placed in the landfill consisted of municipal-type solid wastes generated from on-base housing, barracks, offices, dining facilities, etc. Industrial wastes were also disposed of in the landfill.	1993-1995: Debris, soil, and sediment from LF-2, LF-4, LF-5, and Railway Ditch consolidated into LF-5. 1995-1996: Additional debris and waste soils from LF-6, the underground storage tank (UST) remediation section of the Flightline, Site 34, and Site 72 consolidated into LF-5. LF-5 capped with a composite-barrier-type final cover system. Piezometers, survey monuments, landfill gas monitoring probes and vents were installed after completion of capping. 1994-2004: Long-term monitoring (LTM) and reporting.	1999-2004: annual LTM 2001: established Post-Closure Maintenance and Monitoring Plan (PCMMP) 2003: optimized LTM (PCMMP, Revision 3)	Weston, 1993: ROD for Source Area Remedial Action at Landfill 5 Weston, 1995: Zone 1 ROD
Zone 2	Leaded Fuel Tank Sludge Area (LFTS, Site 10); Burn Area 1 (BA-1, Site 22); Burn Area 2 (BA-2, Site 37); McIntyre Road Drum Disposal Area (MRDDA, Site 43)	Weston, 1993: Zone 2 RI Report; Weston, 1993: Zone 2 FS Report; Weston, 1995: Zone 2 ROD; Bechtel, 1997: Site 22 Remedial Action (RA) System Start-Up Report; Bechtel, 1999: Five-Year Review Report; Bechtel, 2000: Zone 2 OPS (Final); MWH Americas, Inc. (MWH), 2002: Site 10 Test Pit Investigation - Technical Memorandum (Tech Memo); MWH, 2002: Tech Memo – Site 10-Source Area	Zone 2 is located in the northwestern portion of Pease AFB. Site 10 consists of two separate areas on the eastern and western sides of Nottingham Rd., both within approximately 300 ft of Site 22. From late 1950s-1978, the site was used for disposal of sludge obtained from leaded aviation gasoline tank cleaning operations conducted at the onsite bulk fuel storage area (BFSA). An estimated 350 gallons	Sites 10 and 37: 1997-2004: LTM and reporting ongoing. Established Groundwater Management Zone (GMZ) Site 22: 1997-2000, 2002: In-situ soil vapor extraction/air sparge (SVE/AS) for removal of light-nonaqueous phase liquid (LNAPL) and	1999-2004: annual evaluation of system performance and progress toward cleanup goals; LTM 1999: optimized LTM (Long Term Monitoring Plan [LTMP], Revision 1) 2000: OPS demonstrated and accepted	Weston, 1995: Zone 2 ROD

Table 7.2-1
Category 1 Sites (Remedial Action Implemented)
Data Summary Table
Five-Year Review Report
Former Pease Air Force Base, Portsmouth, NH

Site I.D.(1)	Sites Included(2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations from Last 5-Year Review (6)	Remarks (7)
		Investigation Results: MWH, 2002: Site 22 Soil Confirmation Data Report	(gal) of sludge containing water, rust, residual fuels, fuel sludge, and residue from sand-blasting tank interiors was generated during the approximately 20-yr disposal period. Site 22 is located in the central portion of Zone 2. From 1954-1976 the site was reported to have been used as a fire training area and a site for burning spent fuel solvents. The primary contaminant source was found to consist of 2 circular areas of blackened or stained surface soil with little of no vegetation. Site 37 is located southwest of Site 10, adjacent to the eastern side of McIntyre Rd., and covers approximately 3.4 wooded acres surrounding roughly circular areas characterized by blackened surface soil with little or no vegetation. The site is suspected to have been a former fire training area or waste solvent burn area between the years 1954-1976. Site 43, is located on the north-western side of McIntyre Rd, opposite Site 22. Little information is available concerning the history or use of the site. A cluster of 55-gal drums and 5-gal cans were partially exposed at the surface, and the area was suspected to be the site of historic subsurface disposal activities. Investigation activities did not find any evidence of subsurface disposal.	residual product in the soil and treatment of extracted soil vapor for volatile organic compounds (VOCs). 1997-2004: LTM 2002: Soil confirmation sampling.	2001: optimized LTM (LTMP, Revision 2)	

Table 7.2-1
Category 1 Sites (Remedial Action Implemented)
Data Summary Table
Five-Year Review Report
Former Pease Air Force Base, Portsmouth, NH

Site I.D.(1)	Sites Included(2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations from Last 5-Year Review (6)	Remarks (7)
Zone 3, Sites 34/39	Building 229 (Site 33); Building 222 (Jet Engine Test Cell [JETC]- Site 34); Building 120 (Site 38); Building 227 (Site 39)	Weston, 1993: ROD for Site 34; Weston, 1995: Tech Memo - Site 34/39 Performance Test; Weston, 1995: Zone 3 ROD; Metcalf and Eddy, 1995: Site 34-JETC Source Area RA Report; Bechtel, 1998: Zone 3 Excavations Remedial Action (RA) Report - Draft Final; Bechtel, 1999: Five-Year Review Report; Montgomery Watson, 2001: Tech Memo - Site 39 Groundwater (GW) Investigation 2001; MWH, 2002: Site 39 2001 GW Investigation Report; MWH, 2003: Tech Memo - Phase II Site 39 GW Investigation Report; MWH, 2003: Tech Memo - Site 39 GW Investigation Phase III.	Zone 3 is located in the center of Pease AFB. Site 34 (JETC) was constructed in the late 1960s and operated from 1970-1990. The JETC was used to test the performance of jet engines over complete power ranges. Liquid generated from activities at JETC potentially contained polycyclic aromatic hydrocarbons (PAHs.) fuel, hydraulic fluid, and solvents. Before 1989 waste liquid from JETC drained directly to the Test Cell Ditch, which forms the uppermost section of Grafton Ditch. Other contaminant sources at the site are the former 5,000-gal UST that was used to store jet fuel, the oil/water separator, and two No. 2 heating fuel USTs. Site 39 includes the largest hangar at Pease AFB, which served as a major maintenance area for aircraft. The hangar was used for activities including degreasing, paint stripping, minor repairs, and washdown of aircraft. The northern quarter of the hangar housed a washdown rack area and a hazardous waste storage area (HWSA) for 55-gal drums. The soil and groundwater adjacent to and under the building are the primary areas of concern. Contaminant sources are suspected to be: solvents, oil, and fuel spills; and wastewater discharged to the Flightline storm sewers from the building drainage system.	1993: Established and implemented GMZ (monitoring continues to present). 1994: Sediment removal from the Test Cell Ditch. 1995-2004: Long-term environmental performance monitoring and groundwater extraction system performance monitoring. 1996: Soil excavation/ removal from Site 39. 1997-2002: Groundwater extraction and treatment at the Site34/39 Groundwater Treatment Plant (GWTP), including process/performance monitoring. 2004: Optimization of Site 39 groundwater extraction system w/treatment at Site 32 GWTP. 2004: Design/construction of contingency Haven wellhead treatment system (in progress)	1999-2002: annual evaluation of Site 34/39 GWTP performance. 1999-2004: long-term groundwater monitoring throughout Zone 3 1999-2004: performance monitoring of Site 39 groundwater extraction system 1999: LTM optimization (Revised LTMP) 2003: Zone 3 ROD Amendment 2004: Optimization of Site 39 groundwater extraction system w/treatment at Site 32 2004: Design/construction of contingency Haven wellhead treatment system (in progress)	Weston, 1993: ROD for Site 34 Weston, 1995: Zone 3 ROD MWH, 2003: Zone 3 ROD Amendment

Table 7.2-1
Category 1 Sites (Remedial Action Implemented)
Data Summary Table
Five-Year Review Report
Former Pease Air Force Base, Portsmouth, NH

Site I.D.(1)	Sites Included(2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations from Last 5-Year Review (6)	Remarks (7)
Zone 3, Sites 32/36	Building 113 and Building 119	Weston, 1992: Site 32/36 RI Report Draft Final; Weston, 1993: Site 32/36 Pilot GWTP Interim Remedial Measure (IRM) - Letter Report; Weston, 1993: Stage 3C Revised Draft Final Site 32/36 FS; Weston, 1995: Revised Site 32 Technical Impracticability Evaluation Report; Weston, 1995: Revised Final Site 32/36 FS Addendum No. 1; Weston, 1995: ROD for Site 32/36; Weston, 1995: ROD for Zone 3; Bechtel, 1999: Five-Year Review Report; Bechtel, 2000: Site 32/36 OPS Final Report; MWH, 2003: Zone 3 ROD Amendment	Site 32 encompasses Bldg. 113 which was used from 1955-1991 primarily for aircraft munitions systems and avionics maintenance, including vapor degreasing operations. A 1,200-gal UST was located near the northeastern corners of the building, and received waste trichloroethene (TCE) from degreasing operations conducted inside Bldg 113 from 1956-1968. This UST is believed to be a primary source of TCE contamination at the site. Site 36 encompasses Bldg 119 where jet engine and engine accessory maintenance was performed from 1956-1990. Before 1971, waste from the building, including fuel and TCE, was disposed at Site 8. From 1971-1990, these wastes were either stored in a designated drum storage area onsite for contractor removal or were piped to Bldg 226 for treatment. An underground sewer line located along Dover Ave, north of Bldg 119, transported the wastes between buildings. A break in the line resulted in a release of contaminants.	1990: Overflow pipe and contaminated soil near former Site 32 TCE UST excavated. 1991-1995: Pilot groundwater extraction and treatment at Site 32. 1997-2004: Full-scale groundwater extraction and treatment at the Site 32 GWTP. 1992-2004: Long-term environmental performance monitoring, groundwater extraction system performance monitoring, and process monitoring. 1996: A total of 1,403 tons of Chlorobenzene contaminated soil was removed from Site 36.	1999-2004: LTM, extraction/treatment system optimization and process/performance monitoring, and evaluation of natural attenuation processes 1999: LTM Optimization (Revised LTMP) 2000: Site 32/36 OPS 2003: Zone 3 ROD Amendment	Weston, 1995: ROD for Site 32/36 Weston, 1995: Zone 3 ROD MWH, 2003: Zone 3 ROD Amendment
Zone 4, Landfill 6	Landfill 6 (LF-6)	Weston, 1993: Zone 4 RI Report; Weston, 1993: Zone 4 FS Report; Weston, 1995: Zone 4 ROD; Bechtel, 1998: Remedial RA Report; Bechtel, 1999: Five Year Review Report; USAF, 2000:	LF-6 is a former landfill, approximately 3 acres in size, and is located in Zone 4 on the southeastern boundary of Pease AFB. The site is bordered by Grafton Ditch to the north,	1995 - 1996: excavation and removal of all LF-6 soil and solid waste. Non-hazardous material disposed of in LF-5 before LF-5 was capped.	1999-2004: annual LTM and maintenance 2000: OPS demonstrated and accepted	Weston, 1995: Zone 4 ROD

Site I.D.(1)	Sites Included(2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations from Last 5-Year Review (6)	Remarks (7)
		Landfill 6 OPS Final Report	woodlands and CRD-2 to the east, and wetlands and woodlands to the west and south. LF-6 reportedly received domestic and industrial solid wastes in the early 1970s. Some of this waste may have included spent thinners, solvents, and medical waste from the former base clinic. The refuse was buried in the landfill using trench and fill methods.	Hazardous material was disposed off-base at a treatment/disposal facility. Wetlands were created within the footprint of LF-6 and monitored natural attenuation (MNA) was selected to remediate the contaminated groundwater. 1997 – 2004: LTM and maintenance.	2000: LTM Optimization (LTMP, Revision 1) 2003: LTM Optimization (LTMP, Revision 2)	
Zone 5, Site 8	Fire Department Training Area 2 (FDTA-2)	Weston, 1992: Stage 3C Installation Restoration Program (IRP) Site 8 RI; Weston, 1993: Stage 3C FS for IRP Site 8; Weston, 1994: ROD for Site 8; Bechtel, 1999: Five-year Review Report; Bechtel, 2000: Site 8 (FTDA 2) OPS Final Report	Site 8 is located in the northern portion of Pease AFB in the area designated as Zone 5. The site is bounded by Site 11 to the southeast and CRD-1 to the northwest. Taxiway D is situated to the south. Undeveloped forested land is located along the eastern Site 8 boundary. Site 8 was an active fire training area from 1961-1988. The majority of fire training exercises were performed in large circular pit areas located in the southeastern third of the site. Aircraft crash fires were simulated using up to 1,000 gallons of JP-4 fuel. Before 1971, mixed waste oils, solvents, and fuels were also used in exercises at Site 8. The pit area was presaturated with water, and then waste oils, solvents, and fuel were poured on top of the water and onto mock aircraft. The mixture was allowed to burn for 1-2 minutes before being extinguished	1995-2004: In-situ SVE and GW extraction; system was installed (1995) for treatment of contaminated source area soils. Extracted soil vapors are treated to remove VOCs. Groundwater recovery system captures and treats overburden groundwater containing dissolved-phase contaminants, and prevents continued migration of contaminated groundwater to the bedrock water-bearing zone. GWTP treats recovered groundwater. Treated groundwater is discharged to recharge trenches	1999-2004: operated remedial system, implemented optimization strategies; evaluation of system performance and environmental monitoring 2000: LTM Optimization implemented (Revised LTMP) 2000: OPS demonstrated and accepted 2002: Pilot Study on Dual Phase Extraction System Optimization 2003: LTM Optimization (LTMP, Revision 2 and Operations and	Weston, 1994: ROD for Site 8

Table 7.2-1
Category 1 Sites (Remedial Action Implemented)
Data Summary Table
Five-Year Review Report
Former Pease Air Force Base, Portsmouth, NH

Site I.D.(1)	Sites Included(2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations from Last 5-Year Review (6)	Remarks (7)
				1995-2004: System monitoring and maintenance and LTM.	Maintenance (O&M) Plan, Revision 5)	
Zone 7, Site 45	Old Jet Engine Test Stand (OJETS)	Weston, 1993: OJETS Draft Final RI/FS Report; Weston, 1995: Site 45 ROD; Weston, 1995: OJETS Remediation System Basis of Design; Weston, 1995: OJETS Treatability Letter Report; Bechtel, 1997: Site 45 Startup Report; Bechtel, 1999: Five-Year Review Report; Bechtel, 2000: Site 45 OPS Final Report; Bechtel, 2000: Site 45 Remedial System Closure Report;	Site 45 is located in Zone 7 in the southwestern part of Pease AFB. The site encompasses approximately 0.6 acres and is bordered by Lowery Lane to the east and the Golf Course Maintenance Area to the south. Site 45 is where the OJETS was constructed in approximately 1958 near the southwestern edge of the runway at Pease AFB. The facility consisted of a partially enclosed test stand, an engine control room, a transformer, an in-ground exhaust crib, and 2,500-gal fuel storage tank. Sources indicate that in the mid-1960s the test stand operated at full capacity most of the time. During testing, the engine exhaust was directed out of the northern end of the containment structure toward the rock crib, which was designed to deflect the engine exhaust. Petroleum products, hydraulic fluids, and solvents reportedly were used extensively at the facility before the OJETS was taken out of service in 1976. After the OJETS was removed from service, the engine control room, AST, and transformer were removed.	1994: AS/SVE system installed. 1994-1996: In-situ air sparging (pilot and full scale) for saturated contaminated soil to enhance volatilization and biodegradation of organic contaminants in soil and groundwater. In-situ SVE treatment of unsaturated contaminated soil to extract VOCs and to enhance biodegradation of organic contaminants. 1995-2004: LTM and reporting.	1999-2004: LTM and evaluation of progress toward cleanup goals 2000: OPS demonstrated and accepted 2000: Closure of the SVE/AS Remedial System 2001: LTM Optimization (Revised LTMP)	Weston, 1995: Site 45 ROD

Table 7.2-1
Category 1 Sites (Remedial Action Implemented)
Data Summary Table
Five-Year Review Report
Former Pease Air Force Base, Portsmouth, NH

Site I.D.(1)	Sites Included(2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations from Last 5-Year Review (6)	Remarks (7)
Zone 3, Site 73	Building 234	Weston, 1995: Site 73 RI/FS Report; The Johnson Company (Johnson), 1996: Site 73 Supplemental GW Quality Profiling Report; Johnson, 1997: Supplemental GW Profiling – GW Profiling Phase II -Site 73; Bechtel, 1998: Site 73 Supplemental Characterization Report; Bechtel, 1999: Tech Memo for the Permeable Reactive Wall Siting Study; Bechtel, 1999: Permeable Reactive Wall Technology Demonstration Construction Report; Bechtel, 1999: Five-Year Review Report; Bechtel, 2000: Tech Memo for the Supplemental Sampling at Site 73; Bechtel, 2000: Tech Memo for the Investigation of the Downgradient Portion of the Site 73 Chlorinated Plume; Bechtel, 2001: Site 73 Permeable Reactive Wall Technology Demonstration, Technology Evaluation Report; Bechtel, 2001: Tech Memo for the GW Flowmeter Measurement Results; MWH, 2004: Demonstration of Remedial Actions OPS	Site 73 is located in Zone 3 in the central portion of the former AFB. Site 73 includes Building 234 and surrounding driveways and grassy areas, as well as downgradient areas associated with a groundwater VOC plume. Building 234, where the plume begins, is located on Airline Avenue between Exeter Street to the south and Site 76 to the north. Building 234 was constructed in 1959 and was originally used as a liquid oxygen plant. In 1978, it was converted to house a water demineralization plant. Air Force records for Site 73 indicate that TCE and tetrachloroethene (PCE) were used as solvents and degreasers at Building 234 from approximately 1956 to 1978. Cleaning and degreasing operations were conducted in the vicinity of the concrete area northeast of Building 234, with discharges to the environment apparently occurring in the form of minor spills or runoff associated with these operations.	1999: PRB Installation. 1999-2003: technology demonstration and performance monitoring. 2004: LTM.	1999: PRB installation 1999-2003: technology demonstration and performance monitoring 2004: OPS demonstrated and accepted 2004: LTMP established; LTM on-going	MWH, 2003: Zone 3 ROD Amendment
Zone 3, Site 49	Building 22	R.W. Gillespie & Assoes., Inc., 1997: Phase I and II Environmental Assessment Report; Bechtel, 1997: Site 49 Contamination Assessment Report (CAR) Site 49 Communication Bldg; Bechtel, 1998: Site 49 CAR, Addendum	Site 49 is approximately 5 acres in size and is located at the intersection of Pease Boulevard and International Drive. Air Force records for Site 49 indicate that TCE and PCE were used as solvents and degreasers at Building #22 from approximately 1956 to 1978. Cleaning and	1999: EE/CA, removal action, final remedy selection. 2000: PRB installation 2000-2004: In-situ treatment with zero	1999: EE/CA, removal action, final remedy selection 2000: PRB installation 2000: Performance and LTM Plan established	AFRPA, 2000: Site 49 Remedial Action Decision Consensus Statement MWH, 2003: Zone 3 ROD Amendment

Table 7.2-1
Category 1 Sites (Remedial Action Implemented)
Data Summary Table
Five-Year Review Report
Former Pease Air Force Base, Portsmouth, NH

Site I.D.(1)	Sites Included(2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations from Last 5-Year Review (6)	Remarks (7)
		No.1; TN & Associates, Inc.,; Engineering Evaluation/Cost Analysis (EE/CA) Report, Site 49; Bechtel, 1999; Five-Year Review Report; Versar, Inc., 2000: Tech Memo Supplemental Site Characterization; Air Force Real Property Agency (AFRPA), 2000: Site 49 Remedial Action Decision Consensus Statement; Versar, Inc. 2000: Shallow and Deep PRB Construction Installation Report, Site 49 Remedial Action.	degreasing operations were conducted in the vicinity of the south wing area of Building # 22, with discharges to the environment apparently occurring in the form of minor spills or on-site disposal associated with the normal daily operations.	valent iron PRB. 2002: Establishment of GMZ. 2000-2004: Performance monitoring and LTM.	2000-2004: Performance monitoring and LTM 2002: Optimize LTM (Performance and LTMP, Revision 2)	

Notes:
(1) IRP Zone and site identifier in Bechtel 1999 *Five-Year Review Report*.
(2) Sites addressed in 5-Year Review Report.
(3) Brief listing of major documents and year of finalization.
(4) Brief history of site.
(5) Cleanup actions performed at site, including actions performed during reporting period.
(6) Summary of IRP actions occurring during reporting period.
(7) Document determining remedial action selected for site.

Table 7.4-1

Landfill 5 Groundwater Cleanup Goals
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Medium	Contaminant	Cleanup Goal (μg/L)
Groundwater, Water Table[a]	Benzene	5
	bis(2-ethylhexyl) Phthalate	6
	1,1-Dichloroethane	8.1
	Tetrachloroethene	5
	Trichloroethene	5
	Vinyl Chloride	2
	Aroclor-1260	0.5
	Arsenic	50
	Manganese	942
	Thallium	2
Groundwater, Deep Bedrock[a]	Benzene	5
	bis(2-ethylhexyl) phthalate	6
	1,1-Dichloroethane	8.1
	Tetrachloroethene	5
	Trichloroethene	5
	Arsenic	50
	Thallium	2

[a] - Cleanup goals from the Zone 1 ROD (Weston, 1995)
Definitions:
ROD = Record of Decision
μg/L = Microgram per Liter

Table 7.5-1

Zone 2 Groundwater Cleanup Goals
Sites 10, 22, and 37
Five-Year Review Report
Former Pease AFB, Portsmouth, NH
Page 1 of 1

	Cleanup Goal			
	Site 10 / Site 22		**Site 37**	
Contaminant	**Overburden**	**Bedrock**	**Overburden**	**Bedrock**
Organics (μ g/L)				
Benzene	5	5	--	--
Bis(2-ethylhexyl) phthalate	6	--	6	--
1,2-Dibromoethane	0.05	--	--	--
Ethylbenzene	700	--	--	--
Isopropylbenzene	88.1	--	--	--
Methyl isobutyl ketone	350	--	--	--
2-Methylnaphthalene	13.4	--	13.4	--
Naphthalene	20	--	--	--
Sec-butylbenzene	7.3	--	--	--
Toluene	1000	--	--	--
Trichloroethene	5	--	5	--
1,2,4-Trimethylbenzene	19.8	--	--	--
Inorganics (mg/L)				
Arsenic	0.05	--	--	--
Cadmium	0.005	--	--	--
Lead	0.015	--	--	--
Manganese	0.942	--	--	--

-- Not Required
µg/L = Micrograms per Liter
mg/L = Milligrams per Liter
Source: Zone 2 Record of Decision (Weston, 1995)

Table 7.6-1

Subsurface Discharge Goals Under Site 32/36 ROD
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	**Cleanup Goals[a] (μg/L)**
VOCs	
1,1,1-Trichloroethane	200
1,1-Dichloroethane	81[b]
1,1-Dichloroethene	7
1,2,4-Trichlorobenzene	70
1,2,4-Trimethylbenzene	70
1,2-Dichlorobenzene	600
1,3- Dichlorobenzene	600
1,4- Dichlorobenzene	75
Benzene	5
Chlorobenzene	100
Chloromethane	3[b]
cis-1,2-Dichloroethene (DCE)	70
Dichlorodifluoromethane	1,000[b]
Ethylbenzene	700
Isopropylbenzene	89.1[c]
Tetrachloroethene (PCE)	5
Toluene	1,000
trans-1,2-Dichloroethene	100
Trichlorofluoromethane	2,000[b]
Trichloroethene (TCE)	5
Vinyl chloride	2
Xylenes (total)	10,000
SVOCs	
2,4-Dimethylphenol	730[c]
2-Methylnaphthalene	13.4[c]
4-Methylphenol	350[b]
4-Nitrophenol	60[d]
Acenaphthene	2,190[c]
Benzoic Acid	28,000[b]
Bis (2-ethylhexyl) phthalate	6
Dimethly phthalate	313,000
Di-n-butyl phthalate	3,651[c]
Naphthalene	20[b]
Pentachlorophenol	1

Table 7.6-1

Subsurface Discharge Goals Under Site 32/36 ROD
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	Cleanup Goals[a] (μg/L)
Inorganics	
Arsenic	50
Barium	2,000
Beryllium	4
Boron	620[b]
Chromium	100
Copper	1,300
Lead	15
Manganese	1,500[c]
Mercury	2
Nickel	100
Potassium	35,000[b]
Selenium	50
Vanadium	20[d]
Zinc	2,000[d]

Source: Site 32/36 ROD (Weston, 1995d)

[a] Value presented is a maximum contaminant level (MCL) unless otherwise noted.

[b] New Hampshire Department of Public Health Services.

[c] Concentration based on cancer risk of 10^{-6} or hazard index of one.

[d] EPA Lifetime Health Advisory.

[e] State of New Hampshire ambient groundwater quality standards.

Table 7.6-2

Zone 3 Groundwater Cleanup Goals Under 1995 ROD
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	**Cleanup Goals[a] (µg/L)**
Organics	
Benzene	5
Chlorobenzene	100
Chloromethane	3[b]
1,1-Dichloroethene	7
1,1-Dichloroethane	5
cis-1,2-Dichloroethene (DCE)	70
trans-1,2-Dichloroethene	100
Ethylbenzene	700
Tetrachloroethene (PCE)	5
Toluene	1,000
Trichloroethene (TCE)	5
Vinyl chloride	2
SVOCs	
Bis (2-ethylhexyl) phthalate	6
2-Methylnaphthalene	13.4[c]
Naphthalene	20[b]
Pentachlorophenol	1
Phenanthrene	13.4[c]
Sec-Butylbenzene	7.3[c]
Inorganics	
Aluminum	393[e]
Arsenic	50
Cadmium	18.3
Chromium	100
Lead	15
Manganese	942[e]
Potassium	35,000[b]
Vanadium	20[d]

Source: Zone 3 Record of Decision (Weston, 1995a)

µg/L - micrograms per liter

[a] Value presented is a maximum contaminant level (MCL) unless otherwise noted.

[b] New Hampshire Department of Public Health Services.

[c] Concentration based on cancer risk of 10^{-6} or hazard index of one.

[d] EPA Lifetime Health Advisory.

[e] Maximum concentration of background locations (filtered) (Weston, 1995a).

Table 7.6-3

Zone 3 Groundwater Restoration Goals Under ROD Amendment
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	Restoration Goal (µg/L)[a]
Trichloroethene (TCE)	5
cis-1,2-Dichloroethene (DCE)	70
trans-1,2-Dichloroethene	100
Vinyl Chloride	2
Tetrachloroethene (PCE)	5
1,1-Dichloroethene	7
1,2-Dichloroethane	5
Chlorobenzene	100
Benzene	5
Ethylbenzene	700
Toluene	1,000
Naphthalene	20
sec-Butylbenzene	7.3[b]
2-Methyl-naphthalene	280[c]
Bis(2-ethylhexyl) phthalate	6
Arsenic	23[d]
Lead	15
Manganese	942[d]
Vanadium	256[b]

Source: Zone 3 Record of Decision Amendment (MWH, 2003b).
µg/L - Micrograms per liter
[a] Value presented is a maximum contaminant level (MCL) unless otherwise noted.
[b] Concentration based on cancer risk of 10^{-6} or hazard index of one.
[c] New Hampshire Ambient Groundwater Quality Standard (NHAGQS).
[d] Maximum concentration of background locations (filtered) (Weston, 1995a).

Table 7.7-1

Zone 3 Soil and Sediment Cleanup Goals
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	**Cleanup Goals (mg/kg)[a]**
ORGANICS	
Site 34	
Total BTEX	1.0
TPH	100
Site 39	
Trichloroethene (TCE)	0.12
Upper Grafton Ditch (Sediment)	
Total PAHs	8.94[b]
INORGANICS	
Site 39	
Manganese	623
Upper Newfields Ditch (Sediment)	
Arsenic	33
Cadmium	5
Chromium (total)	80
Lead	42.1
Mercury	0.2
Nickel	46.7
Zinc	120
Upper Grafton Ditch (sediment)	
Arsenic	33
Lead	42.1
Mercury	0.2

[a]Source: Zone 3 ROD (Weston, 1995a) and Site 34 ROD (Weston, 1993c).
[b]Source: Five-Year Review Report (Bechtel, 1999b)

Table 7.7-2

Zone 3 Groundwater Cleanup Goals Under 1995 ROD
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	**Cleanup Goals[a] (µg/L)**
Organics	
Benzene	5
Chlorobenzene	100
Chloromethane	3[b]
1,1-Dichloroethene	7
1,1-Dichloroethane	5
cis-1,2-Dichloroethene (DCE)	70
trans-1,2-Dichloroethene	100
Ethylbenzene	700
Tetrachloroethene (PCE)	5
Toluene	1,000
Trichloroethene (TCE)	5
Vinyl chloride	2
SVOCs	
Bis (2-ethylhexyl) phthalate	6
2-Methylnaphthalene	13.4[c]
Naphthalene	20[b]
Pentachlorophenol	1
Phenanthrene	13.4[c]
Sec-Butylbenzene	7.3[c]
Inorganics	
Aluminum	393[e]
Arsenic	50
Cadmium	18.3
Chromium	100
Lead	15
Manganese	942[e]
Potassium	35,000[b]
Vanadium	20[d]

Source: Zone 3 Record of Decision (Weston, 1995b)

µg/L - micrograms per liter

[a] Value presented is a maximum contaminant level (MCL) unless otherwise noted.

[b] New Hampshire Department of Public Health Services.

[c] Concentration based on cancer risk of 10^{-6} or hazard index of one.

[d] EPA Lifetime Health Advisory.

[e] Maximum concentration of background locations (filtered) (Weston, 1995a).

Table 7.7-3

Zone 3 Groundwater Restoration Goals Under ROD Ammendment
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	Restoration Goal (µg/L)[a]
Trichloroethene (TCE)	5
cis-1,2-Dichloroethene (DCE)	70
trans-1,2-Dichloroethene	100
Vinyl Chloride	2
Tetrachloroethene (PCE)	5
1,1-Dichloroethene	7
1,2-Dichloroethane	5
Chlorobenzene	100
Benzene	5
Ethylbenzene	700
Toluene	1,000
Naphthalene	20
sec-Butylbenzene	7.3[b]
2-Methyl-naphthalene	280[c]
Bis(2-ethylhexyl) phthalate	6
Arsenic	23[d]
Lead	15
Manganese	942[d]
Vanadium	256[b]

Source: Zone 3 Record of Decision Amendment (MWH, 2003).
µg/L - Micrograms per liter
[a] Value presented is a maximum contaminant level (MCL) unless otherwise noted.
[b] Concentration based on cancer risk of 10^{-6} or hazard index of one.
[c] New Hampshire Ambient Groundwater Quality Standard (NHAGQS).
[d] Maximum concentration of background locations (filtered) (Weston, 1995).

Table 7.8-1

Landfill 6 Groundwater Cleanup Goals
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	Cleanup Goal (µg/L)
Organics	
Benzene	5
2-Butanone	170
Chlorobenzene	100
1,4-Dichlorobenzene	75
Trichloroethene	5
1,2,4-Trimethylbenzene	19.8
Vinyl Chloride	2
4-Methylphenol	350
Naphthalene	20
Inorganics	
Arsenic	50
Boron	620
Cadmium	5
Lead	15
Nickel	100

Source: Zone 4 ROD (Weston, 1995)
Definition:
ROD = Record of Decision
µg/L = Microgram per Liter

Table 7.9-1

Site 8 Soil Cleanup Goals
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	Cleanup Goals (mg/kg)
Benzene	1.0[a]
Butyl benzyl phthalate	1.5
Chrysene	2.9
Dieldrin	0.002
Ethylbenzene	1.0[a]
2-Methylnaphthalene	5.4
4-Methyl-2-pentanone	2.8
Naphthalene	1.4
n-Nitrosodiphenylamine	0.36
Toluene	1.0[a]
Trichloroethene (TCE)	0.046
Xylenes (total)	1.0[a]

mg/kg = milligram per kilogram

Source: Site 8 ROD (Weston, 1994)

[a] Represents 1.0 mg/kg of total BTEX (benzene, toluene, ethylbenzene, and xylenes).

Table 7.9-2

Site 8 Groundwater Cleanup Goals
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	**Cleanup Goals (µg/L)**
Organics	
Benzene	5
Bis (2-ethylhexyl) phthalate	6
Bromochloromethane	90
sec-Butylbenzene	7.3
4,4'-DDD	0.177
4,4'-DDT	0.1
1,2-Dibromoethane	0.000501
1,4-Dichlorobenzene	75
1,2-Dichloroethane	5
cis-1,2-Dichloroethene (DCE)	70
trans-1,2-Dichloroethene	100
Ethylbenzene	700
Heptachlor	0.4
Isopropylbenzene	89.1
Methylene chloride	5
2-Methylnaphthalene	12.4
4-Methylphenol	350
Naphthalene	20
Phenanthrene	12.4
Tetrachloroethene (PCE)	5
Toluene	1,000
Trichloroethene (TCE)	5
1,2,4-Trimethylbenzene	19.8
Vinyl chloride	2
gamma-BHC (lindane)	0.2
Inorganics	
Antimony	6
Arsenic	50
Beryllium	4
Cadmium	5
Chromium (total)	100
Lead	15
Manganese	1,500
Nickel	100
Thallium	2
Vanadium	50

Source Site 8 ROD (Weston, 1994)

Table 7.10-1

Site 45 Soil Cleanup Goals
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	Cleanup Goal (mg/kg)
Organics	
Benzene	0.2
Toluene	75
Ethylbenzene	75
Xylenes	750
2-Methylnaphthalene	0.66
Naphthalene	3
Inorganics	
Zinc	92.3
Lead	65.3

Source: Site 45 ROD (Weston, 1995)
mg/kg - milligrams per kilogram

Table 7.10-2

Site 45 Groundwater Cleanup Goals
Five-Year Review Report
Former Pease AFB, Portsmouth, New Hampshire

Compound	Cleanup Goal (μg/L)
Organics	
Benzene	5
Sec-Butylbenzene	7.3
Cis-1,2-Dichloroethene	70
Isopropyl benzene	88.1
2-Methylnaphthalene	13.4
Naphthalene	20
1,2,4-Trimethylbenzene	19.8
Inorganics	
Lead	15
Manganese	1,500

μg/L - Micrograms per liter
Source: Site 45 ROD (Weston, 1995)

Table 7.11-1

Site 73 Groundwater Restoration Goals
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	Restoration Goal (µg/L)
Trichloroethene	5
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	100
Vinyl Chloride	2
Tetrachloroethene	5
1,1-Dichloroethene	7
1,1-Dichloroethane	81

Source: Zone 3 ROD Amendment (MWH, 2003d)
µg/L - Micrograms per liter

Table 7.12-1

Site 49 Groundwater Restoration Goals
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	Restoration Goal (μg/L)
Trichloroethene	5
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	100
Vinyl Chloride	2
Tetrachloroethene	5
1,1-Dichloroethene	7
1,1-Dichloroethane	81
1,2-Dichloroethane	5
2-Butanone	170
Naphthalene	20
Carbon Disulfide	7
Methylene Chloride	5
Dibromochloromethane	0.3

Source: Zone 3 ROD Amendment (MWH, 2003b)
μg/L – Micrograms per liter

Table 8.2-1
Category 2 Sites (Long-Term Monitoring Only, Surface Water/Sediment with Remedial Actions Completed)
Data Summary Table
Five-Year Review Report
Former Pease AFB, Portsmouth, NH
Page 1 of 4

Zone (1)	Sites Included (2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations From Last 5-Year Review(6)	Remarks (7)
Zone 1, Pauls Brook	Pauls Brook	Weston, 1993: Zone 1 Remedial Investigation (RI); Weston, 1993: Zone 1 Feasibility Study (FS); Weston, 1995: Zone 1 Record of Decision (ROD); Weston, 1995: Brooks/Ditches RI/FS; U.S.Air Force (USAF), 1997: Brooks/Ditches ROD; Bechtel, 1998: McIntyre and Pauls Brooks Remedial Action (RA) Report; Bechtel, 1999: Five Year Review.	Pauls Brook begins west of Arboretum Drive slightly north of Site 13 as an emergent wetland. Surface water runoff from Site 13 is directed through stormwater drains and empties into Pauls Brook before it crosses under Arboretum Drive and is carried off-base, eventually discharging in the Piscataqua River. Potential sources of contaminants include runoff from the Paint Can Disposal Area (PCDA) and the Bulk Fuel Storage Area (BFSA). Pesticide residues attributed to routine past routine usage of	1994-2004: long-term monitoring (LTM) of surface water (SW) and/or sediment. 1997: Sediment removal (2,242 tons). Excavation in the cleanup area proceeded until sediment contaminant concentrations were below the cleanup goals.	1999-2003: annual SW and sediment sampling and analysis 2000: LTM optimization 2003: LTM optimization (SW sampling eliminated) 2003-2004: annual sediment sampling for reduced analyte list	Weston, 1995: Zone 1 ROD USAF, 1997: ROD for Brooks/Ditches Operable Unit (OU)

Table 8.2-1
Category 2 Sites (Long-Term Monitoring Only, Surface Water/Sediment with Remedial Actions Completed)
Data Summary Table
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Zone (1)	Sites Included (2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations From Last 5-Year Review(6)	Remarks (7)
			pesticides (not CERCLA releases).			
Zone 3, McIntyre Brook	McIntyre Brook	Weston, 1995: Brooks/Ditches RI/FS; USAF, 1997: Brooks/Ditches ROD; Bechtel, 1998: McIntyre and Pauls Brooks RA Report; Bechtel, 1999: Five Year Review Report.	McIntyre Brook is primary drainage from the Flightline area. The upstream reach of McIntyre Brook is a stormwater drainage discharge point for the drainage system that collects surface water runoff from most of the Flightline runway and aircraft parking apron. McIntyre Brook extends southwestward from the Flightline area to Great Bay. The primary contaminant source associated with McIntyre Brook is fuel-related compounds, including volatile organic compounds (VOCs) and	1997: Sediment removal action performed, covering majority of McIntyre Brook from its headwater to Newington Rd. The removal consisted of excavation of 1,951 tons of sediment from McIntyre Brook. 1998-2003: Annual LTM monitoring for SW and/or sediment.	1999-2000: annual sampling and analysis for SW 1999-2003: annual sampling and analysis for sediment 2000: LTM optimization (SW sampling eliminated) 2003: LTM optimization (sediment sampling eliminated)	USAF, 1997: ROD for Brooks/Ditches OU

Table 8.2-1
Category 2 Sites (Long-Term Monitoring Only, Surface Water/Sediment with Remedial Actions Completed)
Data Summary Table
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Zone (1)	Sites Included (2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations From Last 5-Year Review(6)	Remarks (7)
			polycyclic aromatic hydrocarbons (PAHs). Also, as McIntyre Brook (continued) flows off the base, it receives runoff from wetlands, agricultural areas, residential areas, the roadways, and groundwater discharge.			
Zone 1	Railway Ditch and Flagstone Brook	Weston, 1992: Landfill 5 (LF5) FS; Weston, 1993: LF5 ROD; IT, 1995: Excavation and Relocation of Wastes, Soil, and Sediments Landfill 2 (LF2), Landfill 4 (LF4), and LF5; Weston, 1995: Zone 1 ROD; USAF, 1997: ROD for Brooks/Ditches OU; Bechtel, 1999: Five Year Review	The Railway Ditch and Flagstone Brook represent the primary drainages for runoff from LF5, LF4, LF2, the northern portion of the Flightline, a portion of PCDA, a portion of LF3, and small portion of Site 13. Railway Ditch flows northward along the eastern border of Landfill 5,	1993-1995: Excavation and consolidation/ disposal of Railway Ditch sediments into LF5 that contained contaminants at concentrations exceeding site-specific clean up goals. 1994-2004: Annual SW and/or sediment monitoring for	1999-2003: annual LTM for SW and sediment 2000: LTM optimization (reduction in SW monitoring) 2003: LTM optimization (reduction in sediment monitoring) 2003-2004: annual	Weston, 1993: LF5 ROD Weston, 1995: Zone 1 ROD USAF, 1997: ROD for Brooks/Ditches OU

Table 8.2-1
Category 2 Sites (Long-Term Monitoring Only, Surface Water/Sediment with Remedial Actions Completed)
Data Summary Table
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Zone (1)	Sites Included (2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations From Last 5-Year Review(6)	Remarks (7)
		Report; Bechtel, 2001: LF5 Post-Closure Monitoring and Maintenance Plan (PCMMP)	eventually joining Flagstone Brook, which drains to Little Bay to the north of Pease AFB.	LTM.	LTM for SW (Flagstone and Railway) and sediment (Flagstone Brook) for reduced analyte list.	

Notes:
(1) IRP Zone where site is located.
(2) Sites addressed in Five-Year Review Report.
(3) Brief listing of major documents and year of finalization.
(4) Brief history of site.
(5) Cleanup actions performed at site, including actions performed during reporting period.
(6) Summary of IRP actions occurring during reporting period.
(7) Document determining remedial action selected for site.

Table 8.4-1

Pauls Brook Cleanup Goals for Sediment
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Page 1 of 1

Chemical of Concern	ROD Cleanup Goal (mg/kg)
4,4'-DDD	102
4,4'-DDE	8.58
4,4'-DDT	2.11
arsenic	33
cadmium	0.153
chromium	80
copper	70
lead	42.1
nickel	46.7
zinc	120
PAHs (total)	8.94

Source: Brooks and Ditches ROD (USAF, 1997)

Table 8.5-1

McIntyre Brook Cleanup Goals for Sediment
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Page 1 of 1

Chemical of Concern	ROD Cleanup Goal (mg/kg)
Total PAHs	8.94
Lead	42.1
Nickel	46.7
Zinc	120

Source: Brooks and Ditches ROD (USAF, 1997)

Table 8.6-1

Railway Ditch Cleanup Goals for Surface Water
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Contaminant	Surface Water (μg/L)
Pesticides	
4,4'-DDT	0.001
Metals	
Aluminum	87
Arsenic	48
Cadmium	0.971
Copper	9.98
Iron	1,000
Lead	2.5
Mercury	0.012
Nickel	133
Thallium	40
Zinc	90

Source: Landfill 5 ROD (Weston, 1993)

Table 8.6-2

Railway Ditch and Flagstone Brook Cleanup Goals for Sediment
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Compound	**Flagstone Brook - Sediment (mg/kg)**	**Railway Ditch - Sediment (mg/kg)**
α-Chlordane	-	0.0005
γ-chlordane	-	0.0005
4,4'-DDD	0.002	0.002
4,4'-DDE	0.002	0.002
4,4'-DDT	0.001	0.001
Acenaphthene	-	0.15
Benzo(a)anthracene	-	0.23
Chrysene	-	0.4
Dibenzo(a,h)anthracene	-	0.06
Fluoranthene	-	0.6
Phenanthrene	-	0.225
Pyrene	-	0.35
Total PAHs	-	4
Metals		
Antimony	2	2
Arsenic	-	33
Lead	35	35
Nickel	-	30
Zinc	-	120

Source Landfill 5 ROD (Weston, 1993)

Table 9.2-1
Category 3 Sites (Long-Term Monitoring Only, Surface Water/Sediment)
Data Summary Table
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Zone (1)	Sites Included (2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations From Last 5-Year Review (6)	Remarks (7)
Zone 2	Peverly Brook, Upper Peverly Pond, Lower Peverly Pond, Stubbs Pond	Weston, 1993: Zone 2 Remedial Investigation (RI)]; Weston, 1994: Zone 5 Record of Decision (ROD); Weston, 1995: Zone 2 ROD; Bechtel, 1999: Five-Year Review Report.	The Peverly Brook Drainage is the primary drainage in the system that consists of Peverly Brook and three man-made impoundments: Upper Peverly Pond, Lower Peverly Pond, and Stubbs Ponds (formerly Bass Pond), which discharge into Great Bay. The drainage receives surface water and sediment from Landfill 1 (LF1), Fire Department Training Area (FDTA)-1, Site 12, Construction Rubble Dump (CRD)-1, and Site 43. Seeps have been identified adjacent to LF-1, which discharge to Upper Peverly Pond. A source for metals contamination in the drainage was not defined in the ROD. Pesticide concentrations are attributed to basewide	1992, 1996, 2001: Fish tissue sampling was performed. 1994-2004: Long-term monitoring (LTM) of surface water (SW) and sediment.	1999-2004: annual SW and sediment LTM 2000: LTM optimization (reduced SW and sediment monitoring) 2001: Fish tissue sampling and analysis 2003: LTM optimization (SW monitoring reduced to inorganics; sediment monitoring reduced to inorganics and pesticides [limited locations])	Weston, 1994: Zone 5 ROD Weston, 1995: Zone 2 ROD

Table 9.2-1
Category 3 Sites (Long-Term Monitoring Only, Surface Water/Sediment)
Data Summary Table
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Zone (1)	Sites Included (2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations From Last 5-Year Review (6)	Remarks (7)
			pesticide usage and to pre-Air Force base activities.			
Zone 4	Grafton Ditch	Weston, 1995: Zone 4 ROD; Weston, 1995: Zone 3 ROD Bechtel, 1997: CRD-2 Landfill Cap Post-Closure Maintenance and Monitoring Plan (PCMMP); Bechtel, 1998: Zone 3 Excavations Remedial Action (RA) Report; Bechtel, 1999: Five-Year Review Report.	Grafton Ditch (upper and lower) is the primary drainage feature in the drainage area that receives surface water and sediment from Site 34, Site 40, LF-6, and CRD-2. The headwaters of Grafton Ditch are located adjacent to the Site 34. The ditch is an open surface drainage for approximately 700 feet until it enters a storm drain, known as Upper Grafton Ditch which discharges to another open surface drainage east of Grafton Drive, known as Lower Grafton Ditch. Lower Grafton ditch converges with Hodgson Creek and eventually discharges to the Piscataqua River. Three primary	1995: Surface water and sediment monitoring in the ditch was included as part of the Landfill-6 selected remedial alternative. 1994-2004: SW and/or sediment LTM.	1999-2003: annual sediment monitoring 1999-2004: annual SW monitoring 2000: LTM optimization (reduced SW and sediment monitoring) 2003: LTM optimization (reduced SW monitoring; all sediment monitoring discontinued)	Weston, 1995: Zone 4 ROD Weston, 1995: Zone 3 ROD

Zone (1)	Sites Included (2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations From Last 5-Year Review (6)	Remarks (7)
			contributors to surface water quality of Grafton Ditch were identified as: surface water runoff from LF-6 and CRD-2, and runoff from the industrial areas in Zone 3. Site 34 has contributed polycyclic aromatic hydrocarbons (PAHs) and benzene, ethylbenzene, toluene, and xylene (BTEX) related compounds, and metals to Upper Grafton Ditch. Additionally, aerial fallout of combustion products from aircraft engines and local heating and industrial activities have contributed to this contamination.			
Zone 5	Knights Brook and Pickering Brook	Weston, 1992: Site 8 RI; Weston, 1994: Site 8 ROD; Bechtel, 1999: Five-Year Review Report;	Pickering Brook is the primary drainage in the area that receives surface water and sediment from most of	1994: Site 8 ROD required SW and sediment monitoring, but indicated that neither SW nor	1999-2003: annual SW and sediment monitoring 2003-2004: SW and	Weston, 1994: Site 8 ROD

Table 9.2-1
Category 3 Sites (Long-Term Monitoring Only, Surface Water/Sediment)
Data Summary Table
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Zone (1)	Sites Included (2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations From Last 5-Year Review (6)	Remarks (7)
			Site 8, a portion of Site 11 and a small portion of the northeast corner of the Flightline Area. Knights Brook is the primary drainage in the drainage area that receives surface water and sediment from the remainder of Site 8. Pickering Brook flows off-base to the north and joins Flagstone Brook, which ultimately discharges into the Piscataqua River. The headwaters for Knights Brook originate from both Pickering and Watering Springs. Each of these water bodies are located to the northwest of Site 8, entirely outside the Pease AFB site boundary. Surface water from Watering and Pickering Springs flows into two separate wetlands, which comprise the	sediment posed unacceptable risks, and clean-up goals were unnecessary for these media. 1994-2004: SW and sediment LTM.	sediment monitoring in Pickering Brook for reduced analyte list; SW monitoring only in Knights Brook) 2000: LTM optimization (reduced SW and sediment monitoring) 2003: LTM optimization (continued) (reduced SW and sediment monitoring;sediment monitoring in Knights Brook discontinued).	

Table 9.2-1
Category 3 Sites (Long-Term Monitoring Only, Surface Water/Sediment)
Data Summary Table
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Zone (1)	Sites Included (2)	Site Chronology (3)	Background (4)	Remedial Actions (5)	Implementation of Recommendations From Last 5-Year Review (6)	Remarks (7)
			headwaters for Knights Brook. Drainage from the two wetlands converges and flows north to Little Bay. In the mid 1970s, an underground sprinkler and drainage system was added to the burn area (Site 8) so that JP-4 could be sprayed into the pit area through an underground fuel line. Excess fuel was discharged to a drainage ditch located at the north end of Site 8, which drains to Pickering Brook.			

Notes:
(1) IRP Zone where site is located.
(2) Sites addressed in Five-Year Review Report.
(3) Brief listing of major documents and year of finalization.
(4) Brief history of site.
(5) Cleanup actions performed at site, including actions performed during reporting period.
(6) Summary of IRP actions occurring during reporting period.
(7) Document determining remedial action selected for site.

Table 9.4-1
Peverly Brook Cleanup Goals for Surface Water
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Constituents of Concern	ROD Cleanup Goal (μg/l)
Metals	
Aluminum	896
Arsenic	PQL
Iron	2,890
Lead	5
Manganese	1,970
Zinc	72.9

Source: Zone 2 ROD (Weston, 1995).

μg/l - micrograms per liter

Table 9.4-2
Peverly Brook Cleanup Goals for Sediment
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Constituents of Concern	Cleanup Goal (mg/kg)
Metals	
Arsenic	33
Lead	42.1
Nickel	46.7
Zinc	120

Source: Zone 2 ROD (Weston, 1995)
mg/kg = milligrams per kilogram

Table 9.5-1

Upper Grafton Ditch Cleanup Goals for Sediment
Five-Year Review Report
Former Pease AFB, Portsmouth, NH

Page 1 of 1

Compound	Cleanup Goal (mg/kg)
Total PAHs	8.94
Arsenic	33
Lead	42.1
Mercury	0.2

Source: Zone 3 ROD (Weston, 1995b)